The British Mycological Society

(Recognosce notum, ignotum inspice)

TRANSACTIONS

Cambridge University Press
LONDON: BENTLEY HOUSE

CHICAGO
The University of Chicago Press
(Agents for the United States)

BOMBAY · CALCUTTA · MADRAS
Macmillan

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TRANSACTIONS

Volume XXV

Edited by

J. Ramsbottom, B. Barnes and H. Wormald

CAMBRIDGE
AT THE UNIVERSITY PRESS
1941–2

PRINTED IN GREAT BRITAIN

ANNUAL MEETING

14 December 1940

This year it was again impossible to hold an Autumn Foray. The decision to choose some place where the collecting grounds were sufficiently near to headquarters to avoid the need for transport could not be carried out because the obvious areas were closed to the public. Moreover, about the time arrangements had to be made, an intensive air attack on this country was in progress, and London was having what is popularly called a 'blitz'. As this was more or less continuous, many members were either unable to leave London, or did not wish to do so.

In announcing the postponement of the Annual Meeting to members it was stated that an informal foray would be held at Baslow if sufficient were able to attend; conditions of travel were so difficult, however, that the few wishing to carry on were unable to face a cross-country journey.

The Annual Meeting was held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, on Saturday, 14 December 1940, at 12 noon, the President, Dr H. Wormald, in the chair.

The Treasurer commented on the present satisfactory condition of the Society's financial position.

Mr W. C. Moore was elected President of the Society for 1941 on the recommendation of Council, the General Secretary paying tribute to the valuable work Mr Moore had done for the Society, and his continued interest in its affairs. Dr H. Wormald, Mr E. W. Mason and Mr T. Petch were elected Vice-Presidents. The other officers were re-elected. Messrs R. V. Harris, G. S. Hughes and N. C. Preston were elected members of Council in place of Dr G. R. Bisby, Mr W. P. Findlay and Miss E. F. Noel. The Plant Pathology Committee nominated Messrs W. Buddin, W. R. Day and Dr A. Smith as members of the Committee to replace Messrs W. C. Moore, N. C. Preston and G. Samuel.

In view of the uncertainties of events, it was agreed that no Autumn Foray should be arranged for 1941, but that one would be held if possible. If there is no Autumn Foray, the Annual Meeting will be held in December. Two meetings for the reading of papers were provisionally fixed for February and April, one to be held out of London. Dr E. O. Callen and Messrs F. C. Bawden, W. J. Keyworth and E. M. Long were elected members of the Society.

After lunch, the President, Dr H. Wormald, gave his address on 'Recent Research on Diseases of Fruit Trees and Bushes in Britain'.

The meeting ended shortly after three o'clock. There was no tea, for with the early 'black-out' and the prospect of a 'blitz' it was thought that most members would prefer not to dally. As was to be expected however, there was not a wild rush from the neighbourhood, and several members had tea in company, with plenty to discuss.

J. RAMSBOTTOM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 30 JUNE 1940

Receipts	£	s.	d.
1939			
1 July—Balance brought forward	638	17	11
1940			
30 June—Subscriptions to date	308	15	8
Gifts to Printing Fund	4	1	5
Sale of *Transactions*:			
Current Vols.	109	8	6
Back Vols.	74	16	5
Sale of Reprints	27	13	11
Profit from sale of C. Rea's *British Basidiomycetae*	6	2	3
Deposit Interest	4	6	8
War Loan Interest	17	10	0
	£1191	12	9

Payments	£	s.	d.
1940			
30 June—Cambridge University Press, Cost of 450 vol. XXIII *Transactions* and Reprints ...	556	19	4
Postage, Stationery, etc.			
Treasurer	2	5	0
General Secretary		11	3
Secretary	6	10	2
Sec. Pathological Committee	4	1	9
Editors	1	16	7
Sundry Printing	6	17	1
Fees of Meetings	5	11	9
Nomenclature Reprints	2	12	0
Purchase of *Transactions*	1	0	0
Balance in hand and on deposit	603	7	10
	£1191	12	9

CAPITAL ACCOUNT—Robinson Bequest, £50 }
Cheesman Fund, £150 } invested in $3\frac{1}{2}$% War Loan
Printing Fund, £300 }

A. A. PEARSON, *Hon. Treasurer*

Examined and found correct, F. G. GOULD

PRESIDENTIAL ADDRESS

RECENT RESEARCH ON DISEASES OF FRUIT TREES AND BUSHES IN BRITAIN

By H. WORMALD

It is usual for the Presidential Address to be delivered at the Annual Meeting arranged to coincide with the Autumn Foray. It is natural therefore that the attendance at that meeting should show a preponderance of systematists and field mycologists who perhaps are not particularly attracted by those economic aspects of the Society's activities that appeal to the plant pathologists. As last year, we are again constrained to have our Annual Meeting in London, yet I trust that the field mycologists and systematists are well represented here to-day, for I feel that my remarks will not seem so much like platitudes to them as they might to those plant pathologists who are already familiar with some of the diseases I propose to mention. The field mycologist roams the woods and the hillsides in search of the fungi that are his special interest. The range of the plant pathologist is usually far more limited, yet I hope to show that even in these more closely circumscribed areas he sometimes makes discoveries that rouse his enthusiasm as much as would the finding of an undescribed fungus in the hedgerow.

It must not be assumed that the plant pathologists are solely concerned with the economic aspects of their work. They are primarily botanists, and as such are interested in plants. Their work often leads them to a study of the interreactions of pairs of plants, each pair consisting of a host and the parasite attacking it; this study has the ultimate aim, it must be admitted, of suppressing the parasitic organism or rendering its ravages innocuous, even though botanically it may be of considerable interest. Though as naturalists they may have as much affection for the parasite as for its host, and as mycologists their interest may be biased in favour of the parasite, yet, as plant pathologists, they must use the knowledge, obtained from their observations and experiments, in attempts to eliminate the parasite.

Plant pathologists do not often have that special delight of the field mycologists who so frequently discover fungi not previously described or not recorded for a particular district. Their interests lie chiefly in the discovery of some new aspect of a disease—in adding to our knowledge of the relation between host and parasite, possibly both already well known. They do not, however, despise the satisfaction

derived from discovering an organism not previously recorded, and sometimes in investigating a disease they find that the parasite has not before been described and so they are able to indulge in the pleasure of putting on record the discovery of an undescribed organism.

As most of my own observations on plant diseases have been made in the county of Kent, it is natural perhaps that my chief mycological interests have been in relation to diseases of fruit trees, and it is some aspects of these diseases that I would bring to your notice.

Most of our knowledge of the cause and control of fruit tree diseases in this country has been acquired during the last thirty years or so. Soon after the beginning of the present century E. S. Salmon (already renowned in the mycological world for his work on the Erysiphaceae) became attached to the Agricultural College at Wye in Kent, and it may be regarded that that event marks the beginning of an intensive investigation of fruit tree diseases in Britain that still continues. Before that time many of these diseases had already been noted by such keen mycologists as M. J. Berkeley, M. C. Cooke and George Massee, whose interests, however, were in the fungi causing the diseases rather than in the host plants, and no fundamental experimental work on the control of the diseases had been carried out.

When Salmon went to Wye two diseases—Apple Scab and American Gooseberry Mildew—were causing great losses in the Kentish orchards, so he made a special study of the life-histories and habits of the fungi concerned, and of measures for reducing losses due to their attack. He instructed growers in the preparation and application of Bordeaux mixture, and demonstrated the value of lime sulphur for use against fungous diseases, particularly Apple Scab and the powdery mildews.

In 1911 I had the good fortune to become associated with Professor Salmon and to co-operate in his work, and I owe my interest in fruit diseases to the inspiration of his personality, his wide botanical knowledge, and his more intimate mycological enthusiasm. Round about that time a blossom wilt disease was causing destruction on certain Kentish fruit farms. It was assumed to be caused by *Monilia fructigena*, but preliminary observations showed that the parasite was the related species *M. cinerea*. This discovery roused my own interest in the Brown Rot fungi and the diseases they cause. Other workers too found them an interesting group, and since that time a more intimate knowledge of these fungi—their relationship, mode of parasitism, and control—has been acquired by mycologists in this country and abroad.

After the last war the scientific study of fruit-growing began to receive more serious consideration, largely as a result of a movement by the fruit-growers themselves for an investigation into some of their own particular problems. The Long Ashton Research Station in-

creased its personnel and activities, and the East Malling Research Station, founded in 1913 as an offshoot from the Agricultural College at Wye, rapidly added to its acreage, its laboratories and its staff. As pomology became a more exact science a more intensive study was undertaken of the pests and diseases of fruit trees, not only at those two fruit research stations but also at other institutions. F. T. Brooks (1911, 1913) and his pupils investigated, among other diseases, Silver Leaf, and most of our knowledge of this disease and measures for controlling it we owe to the work carried out under his direction at Cambridge, while, at the John Innes Institution, Miss Cayley made a study of Apple Canker and of Die Back of plum trees. Certain fruit diseases have been investigated in Scotland, Northern Ireland and in Eire, while research on diseases affecting stored fruit has been carried out at the Low Temperature Station at Cambridge and its substation, the Ditton Laboratories, and also at the Imperial College. Thus in the last twenty years or so very much information has accumulated relating to the various diseases to which our fruit crops are subject.

It is impossible in the time at my disposal to review all the fruit diseases that have come under investigation during that period, so I will confine my remarks to a few that have received special notice because of their importance to the fruit-growing industry, or because they illustrate some particular line of research.

Attention has been directed more and more to the physiological processes underlying the infection by parasites, and efforts have been made to determine whether by judicious treatment fruit plants can be made more resistant to disease. All diseases are a result of the derangement of the normal physiological processes, and although it is sometimes convenient to refer to certain disorders as 'physiological' or 'functional' diseases, all we mean is that they are brought about by unfavourable environmental conditions and are not a direct result of an invasion by any parasitic organism or infective virus. It is sometimes impossible to distinguish clearly between physiological and infective diseases, since the physiological condition of the host plant often determines whether or not that plant is conducive to infection by a particular parasite.

Of these so-called 'physiological' diseases one of the most widespread and important in fruit trees is that known as Leaf Scorch. At one time this was suspected to be a result of infection, but Wallace (1927, 1928, 1929) at Long Ashton proved conclusively that this disorder, of apple trees particularly, but found also on currants and gooseberries, is a direct result of lack of potash. This discovery revolutionized manurial treatment in orchards, for it was found that in many of them there was a serious lack of potassium salts, a lack which was not compensated for by the heavy dressings of nitrogenous manures sometimes applied, but only aggravated by such treatment.

On manurial trial plots of apples at East Malling a shortage of potash has been associated not only with Leaf Scorch but also with the appearance of so-called 'ghost flowers' (blossoms paler than normal and evidently unhealthy), followed by a dying back of the branches.

Such 'deficiency diseases' have received great attention in recent years and have led to an investigation of methods for detecting mineral deficiencies in plants. Methods elaborated by Roach (1938) are based on the injection of mineral salts in solution into those plants, which, because of their symptoms, are suspected to be lacking in certain elements; he has shown that not only trees or branches, but individual shoots, leaves, or even parts of leaves can be injected. In this way response to a particular treatment may show within a few days; the nature of the deficiency can thus be diagnosed quickly and steps taken to remedy it. More recently still spectrochemical methods of detecting mineral deficiencies in fruit trees have been employed by Roach (1940) and Thompson (1940) and are yielding most promising results. When these methods of detecting deficiencies become more widely practised there is every hope that functional and deficiency disorders will be more readily recognized and that manures and fertilizers will be applied in a far less haphazard fashion than in the past.

That injection methods may have some therapeutic value has long been recognized, especially in relation to the use of iron salts for chlorosis, and there is some evidence that injection may aid affected plum trees to recover from Silver Leaf. Certain results suggest that injection may sometimes have a prophylactic action also. Thus in one of Roach's experiments not only did injection induce a recovery from chlorosis but the leaves on treated branches were found to be more resistant to frost injury; in another experiment apple trees injected with sodium thiosulphate showed less mildew than untreated trees. Whether such methods of protection against diseases will ever be introduced in practical fruit-growing must be left an open question at present.

To turn to diseases with a more mycological interest we find that here again, with a wider outlook, the plant pathologist is no longer content with merely identifying a fungus and then prescribing 'grubbing up and burning' or spraying with Bordeaux mixture. More attention has been given to the reaction of the host plant and to means of enabling it to resist attack. Mention has already been made of Silver Leaf; it is one of the most destructive diseases of plum trees, but it affects other varieties of fruit trees, and may cause serious loss in top-grafted apple trees. Measures directed against this disease as a result of Brooks's work consist not only in committing seriously infected trees or branches to the flames, but in manurial treatment in an endeavour to induce such trees as are already showing Silver

Leaf, but not too far advanced, to throw off the disease (Brooks and Brenchley, 1931), and in protecting open wounds at those periods of the year when the trees are most liable to attack, for experiments showed that exposed tissues are resistant to attack during the summer months but liable to infection at other times of the year (Brooks and Moore, 1926). It was also found that the percentage of recoveries from Silver Leaf in the Victoria plum varied with the variety of rootstock on which the trees were worked. With regard to Silver Leaf Canker in top-grafted apple trees there is evidence from observations at East Malling that this can be avoided largely by adopting 'framework grafting' in place of the customary top-grafting. In frameworking there are no large wounds and there is probably less physiological disturbance to the trees since the main branches are retained, and the trees become well provided with foliage again within a comparatively short time.

Common canker of apple and pear trees has been investigated by a number of workers with the object of obtaining improved means for controlling the disease. Miss Cayley (1921) studied its life-history and cytology, and incidentally found that the apple canker fungus in Britain is not *Nectria ditissima*, as had been generally assumed, but *N. galligena*. Wiltshire (1921 *b*) found that the fungus could infect through the leaf-scars and also through scab lesions. More recently, Marsh (1939) has shown that canker infection through leaf-scars may be initiated in October and April but not in November and January. In one of his experiments a Bordeaux-casein-oil spray, applied in April, resulted in fewer cankers on sprayed shoots than on those left unsprayed, thus suggesting that a spray applied at that time would reduce the chances of infection, although Munson (1939) found that the canker fungus discharges spores during wet periods at all times of the year. It has been shown that the canker fungus not only attacks the stems and branches but is associated with an Eye Rot of the fruit (Salmon and Wormald, 1915; Weston, 1927), and it is to be assumed therefore that the fructifications on the cankers serve as sources of infection for this eye-rot disease.

That the canker fungus is known to infect through scab lesions is important, since it can be inferred that measures directed against scab will indirectly help to prevent canker. This association of canker with scab lesions has been observed also on pear trees (Wormald, 1927), and emphasizes the importance of routine spraying against scab in controlling canker. The physiological relation between parasite and host has received some notice. Certain varieties of apples, not only among those for dessert and cooking but also cider varieties, are found to be more susceptible than others (Umpleby and Swarbrick, 1936), and observations at East Malling suggest that the susceptibility of the scion variety is influenced by the rootstock (Moore, 1934).

The disease that most of all has exercised the minds of horticulturists and the plant pathologists at the fruit research stations is Apple Scab. It is the most troublesome disease with which fruit growers have to contend, and thousands of pounds are spent every year in endeavours to keep it under reasonable control. The early work of Salmon, already mentioned, was continued and amplified by him and his colleagues. Salmon and Ware (1924) were the first to announce the occurrence in Britain of the perithecial stage of *Venturia inaequalis* on the fallen leaves, and of the overwintering of the fungus on the flower-bud scales (Salmon and Ware, 1931) and, in collaboration with the chemists Goodwin and Martin, they carried out extensive spraying trials on apple trees. Of particular notice in this connexion was their introduction of cotton-seed oil for use with Bordeaux mixture; by its means the percentage of copper could be reduced while the mixture still retained its fungicidal properties, with less risk of spray injury (Goodwin *et al.* 1935).

On the physiological aspects of the relation between the parasite and its host may be mentioned the work of Wiltshire (1915) who made a cytological examination of the penetration of the fungus into the host tissues, of Miss K. H. Johnstone (1931) who studied the spore germination and the penetration of the germ tube, and of Marsh and Walker (1932) who described the development of the pustules on the young shoots. Chief attention, however, has been directed to the improvement in the application of fungicides for the control of this disease.

Twenty years ago the recommendations for controlling scab included spraying the foliage and developing fruit with Bordeaux mixture or lime sulphur using a 'fine misty spray', and apparently these measures were tolerably successful, for there seem to have been few complaints of spray injury or of severe infection after such applications. The importance of the disease stimulated increased interest in control measures, and spraying trials were carried out at Wye by Salmon and his colleagues (Goodwin *et al.* 1935), at Long Ashton by Marsh (1931), at East Malling by Grubb (1921, 1924) and by M. H. Moore (1930, 1932, 1936), in East Anglia by Petherbridge *et al.* (1929) and in Northern Ireland by Muskett and Turner (1929). After the discovery that the fungus overwinters in this country on the leaves, and that the perithecia discharge their ascospores early in the spring, it was realized that early applications of fungicides are essential for effective control of scab. This was confirmed by the results of the spraying trials, Marsh (1931) particularly emphasizing the importance of two pre-blossom applications, and now it is customary to spray the trees at least twice before the flowers open—at the green-bud stage and the pink-bud stage.

These pre-blossom applications of the fungicide with at least two

others after the blossoming period, when considered in relation to the increased acreage under fruit and the attention now demanded by other crops on the modern fruit farm, created a difficulty in getting round in time with the fine misty spray, especially when the weather conditions about the blossoming period allowed little time between the green-bud stage and the pink-bud stage. Moreover, the introduction of the 'National Mark' scheme, and the more critical examination of fruit at shows, set a far higher standard for disease control.

These factors led to a consideration of means for more rapidly applying coarser sprays with higher pressures, and the elaboration of power spraying, so that sprays could be directed more effectively to the tops of tall trees. As a consequence there have been various improvements in the spraying machinery. The relative effectiveness of mobile and stationary spraying outfits have been considered by Swarbrick at Long Ashton, and by Turnbull (1939); the latter has shown, too, the value of multiple nozzles for rapid spraying, and he has made a special study of the costings of fruit-tree spraying. The various factors affecting the efficiency of spraying operations has been investigated by Davies (1940) at Wye.

The change from a fine misty spray to a coarser and more wetting spray led, however, to other difficulties. The higher pressures and the drenching sprays caused damage to foliage and fruit, and it was found necessary to modify those concentrations of the spray fluids formerly employed. Again to reduce the number of applications necessary for scab and for insect pests it was found desirable to use spray fluids containing both fungicide and insecticide. These combined sprays have been studied at Long Ashton (Kearns *et al.* 1936) and at East Malling (Moore and Montgomery, 1936).

Meanwhile, substitutes were sought for Bordeaux mixture and lime sulphur, since neither is an ideal spray for apple trees, for at a strength effective against the scab fungus they are likely to cause spray injury, especially on certain varieties. The ideal spray fluid has not yet been found, but commercial firms have introduced a number of proprietary fungicides, such as certain basic copper salts, to replace Bordeaux mixture, and various forms of sulphur, particularly sulphur dusts, 'colloidal' sulphur, and wettable sulphur.

From careful observations on plots with trees on various rootstocks and with different manurial treatments, M. H. Moore (1936) has found that the variety of rootstock and the manurial and cultural treatment of the soil affect not only the degree of susceptibility of the trees to infection by the scab fungus but also their susceptibility to spray injury, and this augurs a new outlook on means for the control of scab. The great problem in the control of diseases by spraying is of course to kill the parasite, or prevent its development, without injuring the host plant. In the apple the range of concentrations of

the active ingredient of the spray fluid within which it is effective without causing injury, is narrow, and varies with the different varieties of apple and with the fungicide employed. Moore's (1940) observations suggest that the range can be extended or diminished according to the conditions under which the trees are growing, and that it can be modified by cultural and manurial treatment. In this connexion recent experiments by Wallace (1939) led him to suggest that magnesium deficiency bears some relation to the susceptibility of apple foliage to spray injury. If these observations are confirmed by future experiments, and are put into practice, it will doubtless lead to a more successful control of Apple Scab.

There is evidence that susceptibility to injury from sulphur sprays in apples is a genetical factor. Tydeman (1941) has found that 21 % of the seedlings from very 'sulphur shy' parent varieties were sulphur shy, while those of sulphur-resistant parents were less than 2 %. These results hint at the possibility of breeding for resistance to spray injury, and should have some bearing on the Apple Scab problem.

In an endeavour to avoid empirical methods of assessing the value of newly introduced fungicides, by laborious and costly field experiments, preliminary laboratory methods of testing fungicides have been elaborated at Long Ashton (Marsh, 1936) and East Malling (Montgomery and Moore, 1938), chiefly with reference to the control of Apple Scab.

This disease then has been viewed from a number of angles, and various lines of research are being followed up. They are already yielding good results, and continued work along those lines should ensure that scab will become even less of a menace to our apple crop than at present.

I have already made a passing reference to the Brown Rot diseases. It may seem of no practical importance to know whether *Monilia fructigena* or *M. cinerea* is the cause of Blossom Wilt, but it must be realized that an exact knowledge of the host relationships of parasitic organisms is necessary in a consideration of the best means for controlling the diseases they cause. Up to 1912 the Brown Rot diseases in Britain had been assumed to be the result of infection by *M. fructigena*, whereas it was then found that both species were in our orchards, and that they could be distinguished by their morphology, their characters in pure culture, and their host relationships (Wormald, 1935*a*, *b*).

Incidentally, a comparison of many strains, collected not only in Britain but also from abroad, led to the conclusion that the common Brown Rot fungus of America was different from either of the two prevalent in Europe. This conclusion apparently stimulated increased interest among American workers, who soon discovered that the American fungus which had gone under the name of *M. fructigena* and

then *M. cinerea* was really *Sclerotinia fructicola*, and now it is generally agreed that the three chief Brown Rot fungi are *S. fructigena* Aderh. & Ruhl. (*Monilia fructigena* Pers.), *S. laxa* Aderh. & Ruhl. (*Monilia cinerea* Bon.), and *S. fructicola* (Wint.) Rehm.

Again it may be asked, of what use are these distinctions from a practical point of view. The answer is that the distribution of the three fungi is not the same. *S. fructicola* occurs in North America, Australia and New Zealand, *S. laxa* in Europe and the North American states bordering on the Pacific Ocean, and *S. fructigena* is confined practically to Europe. This last is an important point since *S. fructigena* is very destructive to the pome fruits while *S. fructicola* causes comparatively little damage to either apples or pears. It is necessary therefore that a watch be kept on *S. fructigena* to see that it is not introduced into those countries (the United States, Australia and New Zealand) in which large quantities of apples are grown for exportation. Again, since *S. fructicola* has not yet become established in Europe reasonable precautions should be taken to see that it does not reach our stone-fruit orchards, for in those countries where it occurs it is particularly destructive to stone-fruits. It has reached these shores, on imported peaches, but up to the present it has not been recorded in our orchards.

The most serious form of Brown Rot infection in Britain is Blossom Wilt caused by *Monilia cinerea* on the apple and Morello cherry, for on these hosts it results not only in the destruction of the blossoms but also in the death of fruiting spurs and branches. A study of the habits and annual cycle of the fungus has enabled practical recommendations to be given to growers for the control of these diseases, which are now generally kept in check except in neglected orchards and gardens.

The first problem of the East Malling Research Station was the standardization of the 'Paradise' rootstocks for apple trees. This involved propagation by layering and stooling. The resulting one-year-old shoots are pulled or cut from the stool or layer and planted out, and later they are grafted with the scion varieties. By this method tissues are left exposed at the base of each shoot and frequently large galls arise there. These galls attracted attention, for it had been shown by Erwin F. Smith and Townsend that such galls were caused by a microbe named by them *Bacterium tumefaciens*, and Crown Gall was considered to be a serious disease. The work at East Malling was directed towards determining whether Crown Gall was really a menace to nursery stocks, and ascertaining the relative susceptibility of the various apple rootstocks under propagation. It appears doubtful, from our own observations, whether these galls do affect the vigour of apple trees to any noticeable extent, for on one plot on the Station trees were planted out, some with galls, others

without, and over a period of about twenty years no significant differences in their vigour or cropping has been detected. With regard to varietal susceptibility some evidence was obtained at East Malling that certain varieties of rootstocks did produce larger and more numerous galls than others (Wormald and Grubb, 1924; Harris, 1931). It should be pointed out that in America, apple varieties are commonly grafted on pieces of root (bench-grafting), and that galls frequently arise at the graft unions. It would seem that such galls, arising about ground level, are more serious than the basal galls of the Paradise apple rootstocks.

As Crown Gall on our own apple rootstocks appeared to be of little economic importance our interest in the disease waned somewhat, but many enquiries were received about it, and galls were found on a number of host plants, particularly raspberries and other species of *Rubus* on which, at times, the galls were evidently causing damage. Thus on cultivated blackberry plants large galls have been found which cause the canes to split into strips at the nodes, and sometimes the lateral branches are transformed into tumours. The work on Crown Gall was resumed therefore and further study was made of strains isolated from various hosts, and of the development of galls on apple stocks. In this connexion it was found by Harris and Pearse (1938) that not only could galls be induced on apple stems by a strain isolated from raspberry but that very similar galls could be caused by a growth-promoting substance.

During the investigations at East Malling, galls, resembling those described as caused by *Bacterium tumefaciens*, have been found on many different species of plants in this country, including, in addition to apple, pear, raspberry, blackberry and loganberry. It is uncertain, however, how many of these are of the Crown Gall type, that is, caused by *B. tumefaciens*. Organisms have been isolated from a number of such galls, and inoculation experiments have shown that some of them can induce tumours on certain host plants. Such strains are therefore probably to be included within the species *B. tumefaciens* although it has been found that their host relationships are not identical, and that they show marked differences in certain culture media.

On the more practical side attempts have been made to confirm results reported on the Continent that organic mercurial compounds aid in controlling Crown Gall on nursery fruit trees, and results in a positive direction, but as yet not very striking, have been obtained. In one experiment, however, the treatment induced a far better stand in the young trees than in the untreated controls; if this is confirmed in further experiments it may prove of value in nursery practice not only in controlling Crown Gall but also in accelerating rooting in nursery apple stocks.

Other bacterial diseases of fruit trees in Britain are really destructive. For many years fruit-growers have experienced great losses in their plum and cherry orchards from what was often referred to as Die Back. The cause of this die back was for a long time in dispute. From the symptoms it would appear that this disease is the one mentioned in the early reports from the Woburn Experimental Fruit Farm towards the end of last century; by different authorities it was then attributed to *Nectria ditissima*, *Micrococcus dendroporthes*, and *Eutypella prunastri*. Other fungi found on affected trees have been suspected of parasitic habits, and unfavourable soil conditions (particularly waterlogging) were also suggested as a cause of Die Back. Possibly some of these factors contribute to the die-back problem, but they do not offer a satisfactory explanation in most outbreaks. In 1920, Wiltshire (1921 *a*), working at Long Ashton, found bacteria in lesions on die-back trees, but on his transference to another sphere of work he was unable to follow up this discovery.

In 1924 and 1925 many trees on the plum trial plots at the East Malling Research Station were dead or dying, and this gave an opportunity for studying the disease more closely, so affected trees were examined carefully during July and August when symptoms were showing clearly. The roots of such trees were quite healthy and had developed normally, thus suggesting that the soil conditions were not the direct cause of the trouble. The affected parts of the trees were found to be along the stem where there was usually a long lesion, sometimes two to three feet long, and often girdling the stem. The bark on such lesions bore fungi at that time of the year, and eight or nine different species were identified. At the region bordering on the healthy parts, however, the cortex contained numerous bacteria which oozed out in dense masses when the tissues were teased out in water. In order to find the relation that these organisms bore to the disease it was necessary to grow them in pure culture, and the usual attempts at isolation were made. They failed completely; even when thickly sown the organisms gave no growth. This suggested either that they did not readily submit to pure culture methods or that they were no longer viable. The latter alternative seemed the more likely and led to the natural assumption that they must have been alive earlier in the year. In 1926 therefore the plum plots were examined in spring for the first appearance of disease symptoms. As soon as stem lesions could be distinguished they were examined, and, as before, dense masses of bacteria oozed out, but now on plating out no difficulty was experienced in isolating and cultivating the organism during April, May and June. Later, however (July and August), attempts at isolation again failed, thus confirming the conclusion drawn in the previous year that the bacteria were present and alive in the affected trees in spring but that they perished during the summer.

The next step was to determine when infection of the stem occurs, so inoculations were made during successive months throughout the year, and it was found that infection during the late autumn and early winter produced the longest cankers and that inoculations in summer yielded no cankers at all. The question then arose: How do the bacteria survive the period between spring, when they are alive in the lesions, and autumn, when they enter other trees to cause further infection? On the same plots where Bacterial Canker was rife, trees, otherwise quite healthy, bore spotted leaves. When the spotted leaf tissues were teased out in water numerous bacteria oozed out. The organism was easily isolated, and in culture was indistinguishable from that found in the stem lesions; this suggested that the same organism could infect either stems or leaves, according to the season, and inoculation experiments carried out with the organism isolated from a leaf induced cankers on plum stems. The bacteria thus spend the winter in producing stem lesions, and in summer they cause leaf spots (Wormald, 1932). There is a similar disease of sweet cherry trees except that in cherries the individual branches are attacked more often than in plums (Wormald, 1937), and also that recently a blossom blight of cherries has been found with an organism in the affected tissues which is apparently the same as one that causes cankers.

What I wish to emphasize is that this so-called die-back is a good example of a disease where control measures depend so much on an exact knowledge of the cause and of the habits of the parasite. When it was thought that a fungus, *Eutypella* for instance, was responsible, all that could be recommended was the removal and burning of affected trees, and this was possible only when such trees could be easily recognized, that is, in summer. By that time, however, the actual parasite is no longer active, and probably dead, so that such measures are utterly useless as a means of control. The measures that are now being put to the test and yielding some success are based on the knowledge acquired of the habits, or seasonal cycle, of the parasite. These measures include spraying in spring and summer to check the leaf-spot phase, spraying in autumn to prevent stem infection, avoiding injuring the stems and branches at certain critical periods, and raising trees with resistant stems top-grafted with susceptible but more valuable scion varieties.

Other bacterial diseases of fruit trees that have come under observation are a blossom blight of pears and a blossom blight and leaf spot of acid cherries. The disease on pears was investigated at Long Ashton (Barker and Grove, 1914) and found to be caused by an organism which has been named *Bacterium Barkeri*. A similar disease of pear trees in the south-eastern counties is associated with two organisms which appear to be different from *B. Barkeri*, so that it

would seem that pear blossoms may be attacked by more than one bacterium. There is no evidence, however, that the Fire Blight organism of pears, so destructive in America, is present in Britain. In a blossom blight and leaf spot of acid cherries bacteria are present in the tissues and two different organisms have been isolated; sometimes one, sometimes the other is isolated under conditions suggesting they are parasites, but definite proof of their parasitism has not yet been obtained.

The bush fruits, including the strawberry, have received a good deal of attention in recent years, and their functional, fungal and virus diseases have been investigated. Among the functional disorders mention may be made of what has been called Dwarf Lateral Scorch of raspberries, the variety Lloyd George being notably susceptible. For long the cause of this disorder was obscure, though certain fungi occasionally found on the crown of severely affected plants came under suspicion. At one time it was thought to be due to winter frosts, until it was noticed that it was generally most severe after mild winters. Experiments carried out by Harris (1940 *b*) offered some confirmation of the supposition that relatively high temperatures during the dormant season induce this disorder. The past winter with its excessively low temperatures over long periods provided a test case for the reliability of this conclusion; not a single example of Dwarf Lateral Scorch was to be found in our own raspberries at the East Malling Research Station, and no enquiries about it were received, although during 1939, after a fairly mild winter, it was very prevalent.

In the late spring of 1939 a disorder of strawberries aroused some interest because the discoloration of the foliage, as scattered reddish spots or marginal blotches, raised a suspicion that the trouble was Severe Crinkle, a virus disease. Field observations, however, suggested that it was the result of unfavourable cultural and weather conditions; it was mostly seen in plants that had been planted late the previous autumn and had produced comparatively few roots, so that during the rather dry weather of the following spring they were behaving more or less as xerophytes with stunted growth and excessive pigmentation of the foliage. Later, when conditions became more favourable, such plants recovered, thus showing that the disorder was of a functional nature and not a virus disease.

Of the fungal diseases of bush fruits American Gooseberry Mildew has been perhaps the most troublesome. It appeared in Great Britain early in the present century and within a few years was widespread and causing great destruction. Salmon tackled the problem and showed that the disease could be controlled by spraying the bushes with lime sulphur (Salmon and Wright, 1912; Salmon, 1913). It was found, however, that some of the favourite varieties were 'sulphur shy', so that lime sulphur could not be used on them without risk of

causing defoliation. Nattrass (1928), at Long Ashton, showed that this could be avoided by employing, instead of lime sulphur, a soda and soap solution, which, though not so effective as lime sulphur, could be used with some success, especially on the sulphur-shy varieties.

A vascular disease of raspberries receiving the name Blue Stripe Wilt, from the colour of the stripe which is often seen extending from ground-level upward along the young canes of diseased plants, was studied by Harris (1925). He found mycelium in the vascular tissues of affected canes, and the fungus when isolated in pure culture proved to conform to descriptions of *Verticillium Dahliae* Kleb.; in inoculation experiments with this fungus he was able to reproduce the disease, thus confirming its parasitism. These results led to an investigation of wilt diseases in other crop plants in Britain, and *V. Dahliae* was found in stems of Morello cherry, black currant, strawberry, and rhubarb, and in quince when propagated by layers as rootstocks for pears, while *V. albo-atrum*, already known to be the cause of wilting in potato and tomato plants in this country, was found to be associated with a serious disease of hop plants.

Cane Spot, with the associated Leaf Spot, of species of *Rubus* caused by *Elsinoe veneta* (Burkh.) Jenkins (*Gloeosporium venetum* Speg.), has received some attention at East Malling, latterly in relation to the loganberry. Measures successfully employed against the disease in raspberry were inadequate for the loganberry, and this was found to bear some relation to the fact that the seasonal cycle of the fungus, especially in the time of maturing and discharge of the ascospores, is different on the two host plants. Moreover, the orthodox methods of training the young canes in the loganberry were found to encourage infection. The application of a copper-containing spray checks the disease, but it has been shown that such measures are most effective when combined with suitably modified methods of training the canes. The fruiting canes are sources of infection, and the training should be such that as the young canes develop they are so placed in relation to the old canes that spores from the fungal fructifications on these canes do not get splashed by rain on to the young growth. Measures for the effective control of Cane Spot on the loganberry and other species of *Rubus* that produce long canes thus involves a consideration of methods of training which obviate infection in this way, and new methods with this end in view have been devised (Beakbane, 1939).

In strawberries various diseases caused by fungi have received some attention, in particular the root rots. Of these the so-called 'Lanarkshire Disease' or 'Red Core' has been responsible for widespread losses in certain strawberry-growing areas in Scotland. Mrs Alcock (1929) found that a species of *Phytophthora* was constantly associated with this disease, and more recently, Hickman (1940),

working at Westerham in Kent where an outbreak had occurred, succeeded in isolating the *Phytophthora* in pure culture, and obtained proof of its parasitism. The fungus proved to be one not previously described and has been named *P. Fragariae*.

The 'Black Root Rot' of strawberries was studied by G. H. Berkeley during a year spent in this country from Canada, and he and Miss Lauder-Thomson found associated with it a number of fungi, among them some that had been shown, or suspected, to be the cause of root rot in strawberries in America (Berkeley and Lauder-Thomson, 1934).

In the small fruits, certain serious diseases have been shown to be transmissible by grafting or by insect agency and are thus considered to be of virus origin. Of these, raspberry Mosaic, strawberry Yellow-edge and Crinkle, and Reversion in black currants threatened to cause great losses, but when their true nature was determined steps were taken to raise disease-free clones for propagation. Of these diseases perhaps the most interesting, as showing a genetical relation of the host plant to the intensity of the symptoms, is Yellow-edge of the strawberry, studied by Harris (1932, 1933) and Miss King (1939), particularly from an etiological point of view and the symptom expression of the strawberry varieties. The original parents of the cultivated varieties of strawberry are *Fragaria chiloensis* and *F. virginiana*. Both these species are susceptible to infection by the virus, but whereas the former suffers very little from the presence of the virus within its tissues, the latter becomes severely affected. Among the cultivated varieties there are some that approximate in appearance to *F. chiloensis* and these too tolerate the virus, while those which more nearly resemble *F. virginiana* are very susceptible and rapidly deteriorate when infected.

Other varieties form a series between the two extremes. Royal Sovereign is a variety which readily succumbs to Yellow-edge, and a Yellow-edge-free clonal strain of this variety was obtained and extensively propagated. It was found, however, that this selected clone contained the virus of Mild Crinkle, a disease which alone causes but little reduction of vigour and fruitfulness of the plants affected by it. Recently, however, there has been found in an isolated spot in western Ireland, a strain of Royal Sovereign free not only from Yellow-edge but also from Crinkle, and this strain is now being propagated in the hope that it may prove to be even more vigorous and prolific than the Yellow-edge-free strain which has recently been distributed. It is to be noted that the varieties of the *chiloensis* type, when infected, function as carriers of Yellow-edge; such varieties show the symptoms of disease little, if at all, but they serve as sources of infection, and so should not be grown in the vicinity of the very susceptible varieties which rapidly deteriorate. Meanwhile the

entomologists became associated with the investigation on these diseases, and Massee (1935) found that the Strawberry Aphis, *Capitophorus fragariae* Theob., is a vector of Yellow-edge, and more recently of Crinkle, in this country.

Mosaic is widespread among species of *Rubus*. Harris (1940*a*) has shown that in raspberries there are two types of mosaic, one (Mosaic 1) which is relatively mild and another (Mosaic 2) which may develop very severe symptoms in some varieties. A serious form of mosaic in the Lloyd George variety has been found by inoculation experiments to be brought about by a combination of Mosaic 1 and Mosaic 2. The vector of raspberry mosaic in this country has not yet been determined, and in the transmission experiments and in the analysis of the symptoms various grafting methods only have been employed. Lately, most success has been obtained by a method of cane-inarching, and this method has been used in the transmission and analysis of symptoms of a mosaic disease of the Bedford Giant blackberry, and of a Dwarf Disease, which at times is very destructive in plantations of the Phenomenal Berry, and has also been seen, though rarely, in the raspberry.

It has been found that the so-called Reversion in black currants can be transmitted by grafting (Amos *et al.* 1927); it is therefore considered to be a virus disease, and there is some evidence that the Big Bud mite serves as a vector. Particular attention has been paid to the recognition of this disease in the field in order that roguing diseased bushes may be carried out with accuracy and despatch, not only in the plantation but especially in the nursery, so that the grower can now be supplied with young bushes free from disease (Lees, 1922, 1925; Amos & Hatton, 1927).

In all these diseases the first step has been the recognition of their virus nature, and this was obtained by means of the grafting experiments which supplied evidence that the infective principle was transmitted in the sap. When their virus nature was established, the next step was the selection and propagation of virus-free clones. Such methods have been employed successfully, and now a grower can rely on obtaining vigorous stocks of certain varieties of raspberry, strawberry and black currant reasonably, if not wholly, free from these virus diseases when planted up. When the vector has been discovered attention has been directed to controlling it, and the Strawberry Aphis and Black Currant Mite have received the special consideration of entomologists in this respect.

Sometimes in our investigations the unexpected happens. The cause of a particular disease may appear to be obvious at first sight, and yet that conclusion may prove to be entirely erroneous when further observations are made. I have already referred to Die Back in stone-fruit trees, and how at first it was attributed to fungi found on the

stems while the actual parasite was within the tissues. More recently a spotting of apple leaves, assumed to be caused by a *Phyllosticta*, has been found to be brought about by an entirely different agent. Wenzl, who discovered this Angular Leaf Spot in Austrian nurseries, confidently assumed (and stated) that the fungus which he found on the spots and named *P. angulata* was the primary cause of the spotting. W. C. Moore (1939) published a clear illustrated account of Angular Leaf Spot as found on apple trees in England, and announced that he too had found a *Phyllosticta* conforming to Wenzl's description, but he made reservations as to the actual cause of the spotting. I, too, had occasion to examine apple leaves showing this disease in 1938 and 1939, and found a *Phyllosticta*; this, however, did not conform to Wenzl's description, and it had a different habit in culture; also on some of the spots there was a *Cladosporium* and not *Phyllosticta*, and as there were thus at least three fungi associated with the spotting doubts began to arise whether Wenzl's *Phyllosticta* was really parasitic, although those of us who examined the damaged leaves were prepared to accept his conclusion pending further investigation. What is probably the real cause of the spotting was revealed last June when Dr Massee and Mr Steer of the East Malling Research Station found an Angular Leaf Spot associated with an infestation by froghoppers. Moreover, they found that when the froghoppers were placed on leaves of apple trees, in the greenhouse or in the plantation, angular spots soon appeared. Meanwhile, some of these froghoppers were sent to Mr Moore at Harpenden who carried out a similar experiment, and apple leaves with spots induced by the froghoppers were examined from time to time during the summer, at East Malling and at Harpenden. In shape and size the spots resembled those illustrated by Wenzl and by Moore, but at first they were darker and more opaque; later, however, they assumed the appearance described for Angular Leaf Spot, and a *Phyllosticta* and *Cladosporium* appeared on the spots (Moore, W. C., 1940). We now assume therefore that Angular Leaf Spot of apple trees is caused, not by a *Phyllosticta*, but by this froghopper, *Cercopis sanguinea* Geoff. The disease thus comes within the purview of the entomologist, although the mycologist may find the fungal flora of the damaged leaves of some interest.

It is not always safe to assume from external symptoms alone that a particular disease is the same as one previously observed. As an instance of two different fungi producing similar symptoms may be mentioned a wilting of shoots of layers and stools of varieties of plums used as rootstocks. This disease was first noticed at East Malling in 1924. The fungus isolated from the underground lesions on such shoots at that time was the Brown Rot and Blossom Wilt fungus *Monilia cinerea*, and in inoculation experiments this fungus was found to produce the symptoms observed in the nursery (Wormald, 1935).

The disease was seen for two or three years but then it disappeared. Later, in 1932, what seemed to be the same disease broke out on another part of the Station. Some of the shoots, however, bore microsclerotia, and this suggested that the fungus present was not *Monilia*. In fact in many attempts at isolations since that time *Monilia* has not again appeared, but the fungus which almost invariably comes up on the plates is one that produces microsclerotia in culture. Although many such shoots were examined over several years no fungal fructifications were found on them, and since on various culture media tried the fungus produced numerous microsclerotia but no fructifications it could not be identified. Eventually, however, fructifications of a *Cylindrocladium* were found on wilting shoots of an apricot layer, and the conidia when germinated on culture plates gave rise to growth indistinguishable from that obtained from plum shoots, so that, pending confirmation from inoculation experiments, the disease now present in our layer and stool rows is assumed to be caused by a *Cylindrocladium*.

This by no means exhausts the list of those diseases of our fruit plants that have come under investigation during recent years. Some of them have been found to be caused by fungi not previously described, as the Fruit-Spotting fungus *Pleospora pomorum* (Horne and Horne, 1920), or by fungi not before recorded for Britain, e.g. *Corticium centrifugum*, the Fish Eye Rot fungus of apple (Colhoun and Muskett, 1935). Other diseases of which the parasitic organisms have been long well known, have been studied from the point of view of obtaining information leading to improved methods of controlling them. Thus Marsh and Maynard (1930) showed that an effective means of checking Currant Leaf Spot, caused by *Gloeosporium Ribis*, was to spray with Bordeaux mixture immediately the fruit is picked, while Saunderson and Cairns (1937) found that Gooseberry Cluster Cups (*Puccinia Pringsheimiana*) could be controlled by spraying with Bordeaux mixture or a 'colloidal copper' preparation if applied about a fortnight before the bushes came into flower.

I have confined my remarks to diseases of fruit trees and bushes, for, working at a fruit research station, I feel more competent to discuss such diseases than those of other crops. It must be borne in mind, however, that other crop plants have simultaneously received their due share of attention, and diseases of glasshouse plants, vegetables (particularly the potato with its many virus diseases), cereals, pasture and forage plants, hops, flax, the mushroom, and ornamental plants, have all come under investigation by plant pathologists at the various agricultural and horticultural research stations and in university laboratories.

In this review I have tried not only to indicate the knowledge we have obtained about these diseases and their control, but also to give

some idea of the methods adopted in acquiring that knowledge. An investigation of a plant disease is no longer merely identifying the parasitic organism and the employment of purely empirical methods for controlling disease. It is a study of the host/parasite complex in relation to the environment, particularly in the direction of rendering the host plant more resistant to attack, and ascertaining the best methods of control with the most effective time of applying direct or indirect measures against the parasite.

In conclusion, may I pay a warm personal tribute (though I know I express the feelings of my fellow plant pathologists) to those members of this Society whose interests lie more on the systematic side of mycology, and are always so ready to render aid in identifying organisms not readily recognized by the plant pathologists, or in naming and describing any newly discovered fungi that the plant pathologists meet with during the course of their investigations. Not all experimental research workers (possibly few) have that special flair for searching into the kinship and nomenclature of the organisms they encounter, and some of them at any rate are only too pleased to be able to relegate that side of the work to others. In this way the varied interests of the members of the Society interact for their mutual benefit. This is probably reflected most clearly in our Committee for Plant Pathology, of which some of the most active and indispensable members are primarily systematists. I trust that the systematists and field mycologists realize that their efforts are fully appreciated and that they are not only adding to our information on that very important group of plants, the fungi, but that they are aiding the plant pathologists to provide humanity with more and better produce of the soil.

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STUDIES ON *SCLEROTINIA* AND *BOTRYTIS*. I.

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(With Plates 1–3 and 1 Text-figure)

De Bary (1866) appears to have been the first to connect the common grey mould, *Botrytis cinerea* Pers., with the Ascomycete *Sclerotinia*. Although Marshall Ward (1888, 358) credits Tulasne, Brefeld and others with discovering the connexion between *Botrytis cinerea* and the Discomycetes, I have been unable to trace such observations. The rise of pure culture technique threw doubt on the relation because cultures started with single conidia of *Botrytis* usually failed to yield apothecia.

This failure has been explained by the work of Drayton (1934), who showed that *Sclerotium Gladioli* Massey occurred in two compatibility groups which 'exhibit intra-group sterility, inter-group fertility, and individual self-sterility'. An apothecial stage (*Sclerotinia Gladioli* Drayton) was produced when spermatia were applied to compatible receptive hyphae in a suitable environment. The method was successfully extended to the genus *Botrytis* by obtaining *Sclerotinia* from *Botrytis convoluta* Whetzel & Drayton (Drayton, 1937) and from *B. cinerea* (Groves and Drayton, 1939). That the process of spermatization leads to true fertilization was demonstrated for *Sclerotinia Gladioli* because cultures from single ascospores when backcrossed with each of the parent isolates showed a segregation of the compatibility factor in a 1 : 1 ratio, thus providing experimental genetic evidence that spermatization leads to a fusion between spermatial and mycelial nuclei.

This pioneer work suggested the studies recorded here. In the belief that the behaviour of the fungi studied by Drayton under controlled laboratory conditions probably indicated similar behaviour out of doors, I tried to find confirmation in the field of the connexion between *Sclerotinia* and *Botrytis*, by exposing material naturally infected with *Botrytis* to conditions in the open air under which the requisite factors outlined by Drayton could operate. The mild humid climate of the south-west of England proved favourable to the search.

METHOD

It seemed probable that the chief obstacle to finding the hypothetical *Sclerotinia* forms in nature lay in the difficulty of finding and identifying the sclerotia on natural substrata after six or more months of weathering on the surface of the soil. Much time was spent looking for leaves bearing sclerotia on *Narcissus* beds, but none were found probably owing to weathering and the activity of worms. To overcome this difficulty sufficient withered leaves of *Narcissus* Soleil d'Or which had been killed by *Botrytis polyblastis* Dows. were raked together during the summer of 1937 to form a pile about four feet high. This was left on the ground at the Isles of Scilly Experiment Station, and examined from time to time. In February 1938 large numbers of apothecia were found developing from sclerotia in the *Narcissus* leaves. As reported previously (Gregory, 1938), these proved to be the unknown apothecial stage of *Botrytis polyblastis*, and the fungus was described and named *Sclerotinia polyblastis*.

Another more or less natural method of exposing sclerotia, and one much less extravagant of material and space, was used in subsequent experiments carried out at Seale-Hayne College, Newton Abbot. The drainage holes of some ten-inch flower-pots were plugged with glass-wool to exclude worms and insects. Material bearing sclerotia of *Botrytis* was placed in the bottom of the pot, or preferably on a layer of sand one inch deep, and the mouth of the pot covered with cheese-cloth. The larger the quantity of plant material the better seemed the chance of success.

The pots were kept on a layer of ashes in an alley between walls on the north and south sides, protected from the sun, but otherwise exposed to the weather, as illustrated in Pl. 1, fig. 1. Conditions inside the pots were damp enough during the winter to favour the growth of liverworts.

During 1938–40, fifty-six pots of material infected with *Botrytis* were exposed and the relationship of any apothecia found was investigated by means of single ascospore cultures. From *B. polyblastis*, apothecia were obtained freely in all fourteen pots used (Pl. 1, fig. 2); from *B. narcissicola* Kleb. in seven out of eight; from *B. cinerea* on dicotyledonous hosts in one out of eleven, and on monocotyledonous hosts in two out of nineteen; and from a new form of *Botrytis* on *Allium triquetrum* in the only pot exposed. If these species are self-sterile both compatibles presumably must have been present in the material when collected, and spermatization must have been brought about by some agent such as mites or movement in water films. Some may have been self-fertile, as apparently were *Sclerotinia Ricini* (Godfrey, 1923) and *S. Porri* (van Beyma thoe Kingma, 1927).

It must not be assumed too readily that apothecia observed in any pot belong to the form of *Botrytis* that was collected. Several Discomycetes were seen which could not be connected with any *Botrytis* stage. One pot full of leaves of *Narcissus* Golden Spur, bearing, when collected, sclerotia of *Botrytis narcissicola*, yielded three recognizably distinct types of apothecia during the winter of 1939-40, and these were studied by means of single ascospore cultures. Two apothecia found in December proved to be the perfect stage of *B. cinerea*. In January, a further specimen of this type developed, and also a crop of apothecia of *Sclerotinia narcissicola*. Towards the end of February there appeared also a fine crop of *S. polyblastis*.

The method has not proved of unlimited success, for sclerotia of *Botrytis* on *Tulipa*, *Galanthus*, *Hyacinthus*, *Scilla*, *Ixia* and *Gladiolus* have so far yielded only conidia (Pl. 2, fig. 2).

The presence of apothecia of a *Sclerotinia* on material infected with *Botrytis*, after a period of exposure, provides only circumstantial evidence of a connexion between the two forms. If conidia of *Botrytis* can be obtained, however, from cultures of single ascospores, then the connexion between the two forms is established as irrefutably as by the more difficult method of cross-mating cultures of conidial origin and so working back from the conidial to the ascospore stage.

Sclerotia, bearing single young apothecia, were placed on moist filter paper in sterile Petri dishes. The apothecia were allowed to shoot ascospores up to a film of plain agar on a cover-glass. Single ascospores were picked off the deposit so obtained and transferred to hanging drops of sterile agar by means of Hanna's (1928) modification of Dickinson's wet-needle technique, using a micromanipulator made from a few Meccano parts. Under optimum conditions, about twenty spores can be picked up in half an hour. This method of isolation permits any chosen spore to be examined at a high magnification before being picked from the spore deposit, again after it has been transferred in isolation to a hanging drop, and as often during germination as required to satisfy the worker that the spore isolated was in fact a single ascospore. A difficulty not yet entirely overcome is that a proportion of the spores fail to grow, apparently because of damage by pressure from the glass needle during isolation. After germination has been observed the agar drop containing the spore is transferred to a culture tube. The results of applying these methods to several species are described below.

1. *SCLEROTINIA POLYBLASTIS* GREGORY

Botrytis polyblastis Dowson (1928) was first known as a parasite of leaves of *Narcissus*. In the extreme south-west, occasional leaf spots occur on varieties of *N. tazetta* in March, but although the leaf may bend over at the lesion, few conidia are produced and the disease makes little progress. It is not until the foliage is beginning to mature and lose its blue-green colour (from the middle of April to May) that the typical epidemic of Narcissus Fire appears. Then, when weather is favourable, the disease begins at a few isolated spots, and sweeps over the field killing the foliage down to the ground in a few days. The apparent resistance of vigorous *Narcissus* foliage to infection by *Botrytis polyblastis* recalls the lettuce leaf which was found by Brooks (1908) to become susceptible to infection by *B. cinerea* only on yellowing. Sclerotia are formed plentifully on the withered leaves but they have not been found on the bulb, and the manner in which they initiate epidemics on the foliage was not known until it was observed that they give rise to apothecia (Pl. 1, figs. 2, 3).

A brief diagnosis of the cup-fungus has been given elsewhere (Gregory, 1938), but a more detailed description can now be given.

The sclerotia are black, smooth, up to 8 mm. long, immersed in the leaf and elongated in a direction parallel to the vascular bundles. They are usually pointed at the ends and somewhat resemble a grain of wheat. They have not been observed to germinate by conidia, but each normally produces from one to four apothecia (Pl. 1, figs. 2, 3) whose disks vary considerably in size, but may reach from 6·0 to 7·0 mm. in diameter when mature. The cup is fleshy and funnel-shaped where it joins the stipe. The stipe is 2–3 mm. long when the sclerotium is superficial but may be elongated and twisted when the sclerotium from which it grows is buried. The base of the stipe is blackened and in this region may bear a few long white hairs; the rest of the stipe and underside of the cup are not hairy, but are covered with minute white scales, which are, however, sparser than in *Sclerotinia narcissicola* described below. The disk is pale raw umber, and the stipe is also raw umber darkening to blackish below. The asci measure $135–180 \times 9–12\,\mu$ with spores occupying $80–90\,\mu$. The ascospores are oval to boat-shaped and measure:

Length: $12–21\,\mu$ (mean of $75 = 17·3\,\mu$; standard deviation 1·84; standard error 0·212).

Breadth: $6–12\,\mu$ (mean of $75 = 8·7\,\mu$; standard deviation 1·004; standard error 0·116).

A frequent but not invariable feature is that a proportion of spores in the ascus may be abortive, and can be recognized as such in the ascus before discharge. Although fully delimited and ejected with the normal spores they appear shrivelled and ghost-like, and fail to germinate. Similar spores are seen in *Sclerotinia narcissicola*.

Evidence of connexion with Botrytis polyblastis

To investigate the connexion between conidial and ascospore forms the following single-spore isolates were prepared and studied in culture:

1938 *Narcissus* Golden Spur, leaves, Scilly Isles: 9 single ascospores.
1939 *Narcissus* Golden Spur, leaves, Scilly Isles: 25 single ascospores.
1940 *Narcissus* Golden Spur, leaves, Scilly Isles: 17 single ascospores.
1938 *Narcissus* Grand Primo, flowers, Scilly Isles: 6 single conidia.
1940 *Narcissus* Golden Spur, flowers, Truro: 11 single conidia.

The media employed were: oatmeal extract agar, prune extract agar, malt extract agar, potato dextrose agar and sterilized stalks of *Narcissus*. When first isolated, the cultures both from ascospores and conidia were remarkably uniform in appearance, producing a small amount of white aerial mycelium, large round or rounded-elongate, flattened, black sclerotia on the surface of the medium often reaching 10–12 mm. in length, and in tube cultures coalescing where the slant meets the glass of the tube. Cultures from single ascospores on potato dextrose agar slants (Pl. 1, fig. 4) are typical of the isolates.

On oatmeal extract agar a culture three or four weeks old usually forms copious cream-coloured slimy masses of microconidia typical of the genus *Sclerotinia*; these are also formed regularly in smaller numbers on other media.

After some months in culture the isolates tend to degenerate towards a mycelial form, first losing sclerotia and eventually microconidia. With this change is associated a raw umber pigment in the medium, which is brightest on the reverse side of the culture. Pl. 1, fig. 5 shows a culture from an ascospore growing on potato dextrose agar. For comparison Pl. 1, fig. 6 shows a recently isolated conidial strain from a single conidium taken from a withered flower.

As *Botrytis polyblastis* has not so far produced conidia in culture it was necessary to resort to plant inoculations carried out with flowers of *Narcissus* grown at Newton Abbot, where the fungus is not known to occur naturally.

In one series of inoculations begun on 9 March 1938, opening flower-buds of the variety Grand Primo, from the glasshouse, were placed in deep dishes lined with moist paper. Each dish contained two buds, one of which remained uninoculated, while the other was inoculated by placing a fragment from a young culture on prune agar on the unwounded surface of the perianth. In this experiment, two isolates started each from single ascospores and five started each from several ascospores, were tested on different flowers. Two of the inoculations with multi-ascospore isolates failed, but in five days the other inoculations caused a rapidly extending brown-rotting of the tissues, and in seven days all the infected buds were bearing the large,

highly characteristic condia of *Botrytis polyblastis*, some of which, when tested, germinated with from five to seven germ tubes. Six conidia were taken separately from the buds inoculated from cultures started from single ascospores, and these gave typical cultures of *B. polyblastis*. The flowers used as controls remained free from attack.

On 21 March, six opening flower-buds of *Narcissus* Empress and four of Scilly White were similarly inoculated by placing portions of agar cultures on the unwounded perianth. Eight different single-ascospore cultures, and two of the single conidial cultures reisolated from the previous experiment, were tested on separate flowers. One of these failed to attack the flower, but the other nine caused a rapid decay of tissue with the production of conidia of *Botrytis polyblastis* within ten days. One of the Empress flowers also developed a growth of *B. narcissicola* as a contaminant.

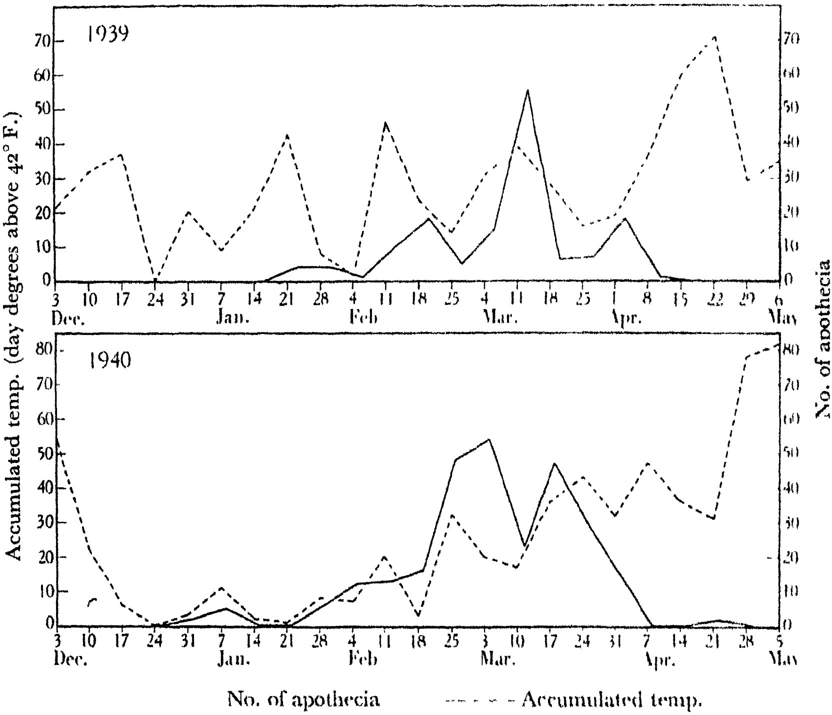
On 13 April, twenty-four leaf tips of Emperor, taken from the open field, were placed on sterile watch-glasses in moist dishes. Twelve of these leaves were inoculated by placing portions of agar culture on the unwounded surface, testing six single ascospore isolates in duplicate. Leaf infection occurred more slowly than when flowers were inoculated, and three of the twelve control leaves developed patches of *Penicillium* during the four weeks in which the series was kept under observation, but no *Botrytis* forms appeared on the controls. On two of the leaves the inoculum dried up, but on ten leaves lesions of varying size were produced below the inoculum. Two lesions produced aerial mycelium and microconidia only, while the remaining six gave conidia of *B. polyblastis*.

The similarity of cultures derived from ascospores and conidia, the production of characteristic conidia of *B. polyblastis* on leaves and flowers inoculated with single ascospore cultures, and the reisolation of the organism from such conidia is regarded as proof of the genetic connexion between the conidial and apothecial fructifications.

The disease in the field. Although described at first as a leaf disease it became apparent that Fire could also cause spotting of *Narcissus* flowers (Moore, 1939). In the south-west of England the occurrence of flower spot presented a mystery because widespread damage was sustained in wet weather some months before any sporulating lesions could be found on leaves to serve as a source of infection. For example, severe spotting of flowers of *Narcissus* Soleil d'Or due to *Botrytis polyblastis* was found by Mr Gordon W. Gibson at St Mary's during the last week of January 1937, yet in spite of careful search neither he nor I found leaf lesions in the district until 2 April, and the disease did not become epidemic on the foliage until the last week in April. It seemed that flower spot infection must either have come direct from the sclerotia on the ground, or from the fungus growing on some other host. This search for *B. polyblastis* on other hosts proved

fruitless but it yielded the fungus on *Allium triquetrum*, described below. The production of apothecia from sclerotia of *Botrytis polyblastis* already described provided a clue to the course of the disease in the field.

Sclerotinia polyblastis has not yet been found to occur naturally on *Narcissus* at Newton Abbot, but in the pots of leaves kept at this centre, apothecia were produced from January to April. During the



Text-fig. 1. *Sclerotinia polyblastis*. Number of apothecia produced weekly by samples of infected leaves 1939 and 1940, showing that when sclerotia are mature cropping is correlated with accumulated temperature (day-degrees above 42° F.).

seasons 1938–9 and 1939–40 records were kept of the number of apothecia that expanded each week at Newton Abbot from sclerotia on a sample of leaves collected during the previous summers at St Mary's. As shown graphically in Text-fig. 1 the production of apothecia started in January, reached a peak early in March, and ended in April, corresponding approximately to the period of flowering in the open of varieties *N. tazetta* and *N. pseudonarcissus* at Newton Abbot. The sclerotia of this fungus remain in a dormant condition until mid-winter, and the internal or external factors that determine their release from this state are obscure. However, when

the sclerotia have matured, in the presence of adequate water in the substratum, the development of apothecia is under the control of temperature. This is shown clearly in Text-fig. 1 where the weekly crop of apothecia is compared with the accumulated temperature (day-degrees above 42° F.) for the corresponding period. Eventually the number of apothecia produced falls off as the sclerotia become exhausted, and no more are produced even at favourable temperatures. If the same sclerotia are exposed for a further season one or two apothecia may be produced in the second spring. These are usually of a pale watery colour, but isolates from single ascospores apparently give normal cultures.

Detailed records of the production of apothecia in the Isles of Scilly are not available, but it is probable that the early flower spots caused by this fungus are direct ascospore infections from apothecia on overwintered sclerotia rather than from conidia on leaf lesions. In the milder climate of the Isles of Scilly the production of apothecia probably reaches its maximum and ceases several weeks before *Narcissus* Fire develops as an epidemic on the foliage.

Direct infection of the *Narcissus* perianth with ascospores has been achieved experimentally. Infections with pieces of agar cultures were readily obtained on flowers as described above, but it was also found easy to infect detached flowers directly with ascospores. Five flowers of Grand Primo were placed on moist absorbent paper in glass dishes, and single apothecia were placed so that their spores were discharged for periods of from two to six hours on the inner or outer sides of the perianth. All these flowers rapidly became infected and developed conidia of *Botrytis polyblastis* within eight days. The experiment was repeated with similar results with six flowers of Soleil d'Or. Inoculation of the uninjured perianth of detached flowers in moist dishes with portions of agar culture resulted in a rapidly progressing brown rot in four or five days, and in seven days, if the dish were not too moist, conidia of *B. polyblastis* appeared. It was evident that the perianth was much more easily infected with ascospores than were the leaves, though portions of leaves also became infected by ascospores ejected from apothecia if kept in moist dishes for about ten days.

Puffing of apothecia was observed on several occasions, and some records of spore discharge have been obtained from apothecia in the open air. An individual apothecium which is shedding spores can be dried and rewetted several times before the period of discharge is completed. The period of discharge appears to vary according to the size of the apothecium. Records of spore discharge were obtained from two apothecia supplied with plenty of water out of doors, the spores being collected on a slide and recorded daily. The larger specimen began to discharge on 6 March, reached a maximum about 20 March, and ceased on 23 March. For a smaller specimen the

corresponding dates were 6, 11 and 13 March. Thus in these two specimens, discharge lasted from seven to sixteen days.

In the field a picker seeing a spotted flower or flower-bud often leaves it on the plant. Soon the whole perianth, ovary, and even part of the stalk wither and become covered with a short dense greyish white layer of conidia, far more luxuriant than is ever found on the leaves where conidial production at its best is somewhat sparse. This phase, which has hitherto been overlooked, is illustrated in Pl. 2, fig. 1, which is a photograph of a withered flower covered with spores collected from a field of Golden Spur at Truro. The identity of the organism present in this collection was confirmed by eleven single conidial cultures. Surveys of *Narcissus* fields shortly after flowering have shown that in the Isles of Scilly, Cornwall and south Devon such profuse spore production on withered flower heads is exceedingly common. It may well be claimed that *Sclerotinia polyblastis* is a virulent parasite of the perianth of *Narcissus* and only attacks the foliage when the leaves are nearing maturity.

Flowers may be left unpicked for a number of reasons besides blemish at the time of picking. They may belong to rogue varieties (e.g. in Golden Spur); they may not be worth picking owing to a glut (e.g. Princeps); and often a few small flowers from offsets appear very late after the main crop has been removed, and these are not considered worth fetching in (e.g. Helios).

Such withered flowers remain for weeks on their stalks producing conidia of *Botrytis polyblastis* in great numbers, yet, as observation shows, the leaves around them must still be relatively resistant to infection. Eventually, with suitable weather as the foliage matures, the disease suddenly spreads over the field. In the first stages of the *Narcissus* Fire epidemic, the leaves are attacked in isolated groups of plants, and inspection at this time invariably reveals a diseased flower acting as a focus for each patch. In the Isles of Scilly growers have noticed that where fields of Princeps are left unpicked the foliage may die off very rapidly. It would be interesting to know whether a light crop from this variety, notably irregular in Scilly, normally follows a glut year when the flowers on many fields are left unpicked and the leaves succumb to an early attack of fire.

The life cycle of *Sclerotinia polyblastis* can now be pieced together. At the end of the winter the sclerotia produce apothecia at about the time when *Narcissus tazetta* and *N. pseudonarcissus* are in flower. The ascospores infect the perianth and may cause widespread flower spotting, but the leaf tissue is apparently resistant to infection at this time. The fungus survives on withered flowers and these produce enormous numbers of conidia which cause an epidemic on the maturing foliage. On the leaves, conidia are also produced somewhat sparsely, and these no doubt serve to disseminate the disease.

Eventually the leaves produce large numbers of sclerotia. For the practical control of the disease there are two obvious points in the life cycle at which the fungus can be attacked by sanitation methods, although so far their effect has not been studied experimentally. These are: (1) removal and destruction of all withered *Narcissus* foliage during summer in order to get rid of most of the sclerotia and thus to reduce flower spot during the following year; and (2) removal from the field of all flowers in order to break the cycle between sclerotium and leaf infection. If done thoroughly these measures should go far towards preventing Fire epidemics.

2. *Sclerotinia narcissicola* n.sp.

Botrytis narcissicola Kleb. causes a disease of *Narcissus* known as Smoulder or Grey Mould which may rot the leaves at ground level, simulate *Narcissus* Fire on the foliage, cause a spotting of the perianth or, sometimes, rot the bulbs. Sclerotia on leaves kept in pots at Newton Abbot germinated by means of conidia from early in December onwards (Pl. 2, fig. 2), and these may be the source of flower spotting in winter, but it is possible that some of the flower infection is by means of ascospores.

On 6 March 1939 apothecia (Pl. 2, fig. 3) as well as conidia were found developing from sclerotia on old leaves of *Narcissus* Golden Spur which had been affected with Smoulder when collected during the previous spring at St Mary's, Isles of Scilly. From January to March 1940 apothecia were again produced on more material from the same field at St Mary's, and also on leaves of *Narcissus* Double White collected with Smoulder in 1939 in the Tamar Valley. The peak of apothecial production at Newton Abbot appeared to be during March.

To ascertain whether these apothecia were connected with *Botrytis narcissicola*, a number of single ascospore and single conidial cultures were obtained in the manner described above from sclerotia on leaves of Golden Spur from St Mary's, and compared:

Overwintered sclerotia 1939: Single conidia, 5 cultures.
Single ascospores, 9 cultures.
Overwintered sclerotia 1940: Single conidia, 4 cultures.
Single ascospores, 6 cultures.

Sample cultures from the various groups of isolates were grown for comparison on oatmeal extract agar, malt extract agar, and potato dextrose agar and showed the superficial greyish, felty, aerial mycelium (Pl. 2, fig. 4), with small flat rounded sclerotia evenly distributed over the surface of the medium (Pl. 2, figs. 5, 6), recognized as characteristic of *B. narcissicola*, and it was concluded that the apothecia

found on the aestivated sclerotia were in fact the perfect form of this fungus.

In the summer of 1939 a few typical conidiophores and conidia of the *Botrytis* type were produced in several single ascospore cultures on oatmeal extract agar. *B. narcissicola* does not normally produce conidia freely in culture, therefore a series of single-ascospore and single-conidium isolates were transferred to portions of flower stalks of *Narcissus* which had been sterilized by autoclaving in plugged tubes in an attempt to obtain more conidia. When young, the cultures on this medium did not sporulate, but after five months the tubes were brought out of a cupboard, and when kept in the light for a few weeks the sclerotia developed profuse masses of conidia of the *Botrytis* type (Pl. 2, figs. 7, 8). This profuse production of conidia of *Botrytis* from single ascospore cultures on sterilized stalks of *Narcissus*, together with the characteristic mycelium and small sclerotia on other media, confirms the conclusion that the apothecia are the perfect stage of *Botrytis narcissicola* Kleb., and the name *Sclerotinia narcissicola* is accordingly proposed.

Sclerotinia narcissicola n.sp.

Synonym: *Botrytis narcissicola* Kleb.

Sclerotia black, smooth, more or less globose, 1–1·5 mm. in diameter. Apothecia arising singly from sclerotia in winter and spring, cup-shaped, becoming funnel-shaped, disk flat, reaching 2·5 mm. in diameter, warm sepia to raw umber when mature. Stipe raw umber 1·5–5 or more mm. long, tapering towards the blackish base. Under side of cup, and the stipe, covered with minute, somewhat revolute white to brownish scales.

Asci 120–140 × 8 μ, spores occupying 60–90 μ.

Ascospores 8, 1 or 2 seriate, hyaline, indistinctly biguttulate, naviculate, 10–20 × 5–9 μ (mean 15·4 × 7·1 μ).

Samples of ascospores taken from the apothecia gave the following measurements:

Number of spores measured	Length μ	Standard deviation	Range μ	Breadth μ	Range μ
27	15·3	1·170	13–18	7·1	5–9
25	14·1	0·782	12–16	6·7	6–8
25	15·5	1·893	12–20	7·2	6–8
50	13·1	1·464	10–17	5·97	5–7
50	14·5	1·418	13–18	6·56	5–9

Conidial stage: *Botrytis narcissicola* Kleb.

Habitat: at Newton Abbot on sclerotia on aestivated leaves of *Narcissus pseudonarcissus* from St Mary's, Isles of Scilly (Type), and *N. poeticus* from Bere Alston, Devon.

Sclerotinia narcissicola sp.n.

Apothecia Warm Sepia, in maturitate Raw Umber (Ridgway), squamis albidis vel pallide brunneis cincta, plerumque singula e sclerotio nigro, nonnihil globoso, laevigato 1·0–1·5 mm. diam. oriunda, primo cyathiformia, dein infundibuliformia sed disco plano praedita, ad 2·5 mm. diam.; stipites similiter colorati cinctique, ad basim nigrescentem versus teretes. Asci cylindracei, 120–140 × 8 μ (p. sp. 60–90 μ). Ascosporae 8, mono- vel distichae, naviculares, hyalinae, indistincte biguttatae, 10–20 × 5–9 μ (in medio 15·4 × 7·1 μ). Status conidialis *Botrytidi narcissicola* referendus.

3. *Sclerotinia sphaerosperma* n.sp.

In April 1937 a curious *Botrytis* was found on *Allium triquetrum*, a troublesome weed in the Isles of Scilly. On plants in a hedge at the Experiment Station, St Mary's, were found numerous white leaf-spots bearing a sparse layer of conidia (Pl. 3, fig. 1) which bore some resemblance to those of *Sclerotinia polyblastis*. The disease has since been seen each year in the same spot but has not been found elsewhere. The highly characteristic conidia which are borne in a single whorl on stout unbranched conidiophores are spherical, averaging about 23 μ (Pl. 3, figs. 3, 4) and germinating by three or four germ tubes. *Botrytis globosa* (Raabe, 1938) on *Allium ursinum*, appears somewhat similar but has much smaller conidia.

In May 1939, a quantity of infected leaves bearing sclerotia was collected and placed on a layer of sand in a pot at Newton Abbot. When examined on 6 December 1939, numerous apothecia (Pl. 3, fig. 2) were found growing from the sclerotia. More apothecia were found on 11 January 1940, but none developed later. The occurrence of conidia on the sclerotia has not been observed in this species.

Apothecia were brought into the laboratory and twenty single ascospores were isolated in hanging drops by the usual method. Evidently the spores of this species are very fragile, for eighteen of them failed to grow and the drops of agar remained sterile. Two, however, gave mycelia which closely resemble cultures from single conidia, as illustrated in Pl. 3, figs. 5, 6. Young cultures from single ascospores on malt extract agar produce the large spherical conidia in small heads freely over the surface of both mycelium and sclerotia, thus establishing the genetic connexion between conidia and apothecia. The fungus appears to differ from related species described previously, and it is accordingly named *Sclerotinia sphaerosperma* with reference to its spherical conidia.

Sclerotinia sphaerosperma n.sp.

Sclerotia, black, ovate-sphaeroidal, 1·5–2·5 × 0·5–1 mm. Apothecia one or two arising from each sclerotium, cup-shaped, becoming discoid, flat, 1–1·5 mm. in diameter, by 0·3 mm. thick, warm sepia.

Underside of cup and stipe smooth. Stipe isodiametric, dark at base, 1·5–33 mm. long.

Asci 240 × 14–15 μ, spores occupying half the length.

Ascospores 8, hyaline, uniseriate, with one or more guttules, naviculate, 17–26 × 8–12 μ (mean of 50: length 21·24 μ; standard deviaton 4·884; standard error 0·691; breadth 9·98 μ; standard deviation 4·12; standard error 0·583). Some abortive spores present.

Conidial stage of *Botrytis* type. Conidiophores hyaline, short, 160–700 μ long by 7–20 μ broad, rarely branched. Conidia in compact heads, usually a single whorl, hyaline, spherical, germinating with 1–4 germ tubes. Conidial measurements:

(1) From living leaves: 20–28 μ diameter (mean of 50 spores: 23·2 μ; standard deviation 1·952; standard error 0·276).

(2) In culture from a single ascospore: 18–28 μ (mean of 50 spores: 22·9μ; standard deviation 7·235; standard error 1·023).

Habitat: Conidial stage on leaf spots on *Allium triquetrum* in spring at St Mary's, Isles of Scilly. Apothecia in winter from sclerotia on aestivated leaves of *Allium triquetrum* from St Mary's, Isles of Scilly, at Newton Abbot, Devon.

Sclerotinia sphaerosperma sp.n.

Apothecia Warm Sepia (Ridgway), e quoque sclerotio nigro, ovatogloboso, 1·5–2·5 × 0·5–1·0 mm., singula vel dua oriunda, primo cyathiformia, dein discoidea, laevigata, 1·0–1·5 mm. diam., 0·3 mm. crassa; stipites cylindracei, basim versus nigrescentes, laevigati 1·5–3·0 mm. alti. Asci cylindracei, ascosporas in parte superno gerentes, 240 × 14–15 μ. Ascosporae 8, monostichae, naviculares, hyalinae, guttulis singulis vel pluribus praeditae, 17–26 × 8–12 μ (in medio 21·7 × 10·0 μ); aliquando abortivae.

Status conidialis *Botrytidi* referendus.

Conidiophora robusta et brevia, hyalina, 160–700 × 16 μ. Conidia in capitulis compactis, plerumque in verticillo singulo dispositis, producta, globosa (ergo *sphaerosperma*), hyalina, 20–28 μ diam. (in medio 23·2 μ), per tubos germinationis singulos ad quatuor pullulantia.

This work was mainly carried out at Seale-Hayne Agricultural College, Newton Abbot, with financial assistance from the Great Western Railway Company through the Cornwall Farmer's Union, and the Ministry of Agriculture and Fisheries upon the recommendation of the Agricultural Research Council to whom grateful acknowledgements are made. Thanks are also due to Mr W. C. Moore for help with literature and to Mr E. W. Mason who wrote the Latin diagnoses.

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EXPLANATION OF PLATES 1–3

PLATE 1. *Sclerotinia polyblastis*

Fig. 1. Method of exposing plant material bearing sclerotia of *Botrytis* for production of apothecia during winter and spring under natural conditions at Newton Abbot.

Fig. 2. Group of apothecia from sclerotia on leaves of Narcissus Soleil d'Or, 4 March 1938 (× 2·7).

Fig. 3. Apothecia produced singly from sclerotia, 4 March 1940 (× 5·2).

Fig. 4. Six single-ascospore cultures isolated 8 February 1940 after three weeks' growth on potato dextrose agar.

Fig. 5. Single-ascospore culture on potato dextrose agar from apothecium from leaves of *Narcissus* Grand Primo, collected Scilly Isles 1938, isolated April 1939.

Fig. 6. Single conidial culture on potato dextrose agar of *Botrytis polyblastis* from withered perianth of *Narcissus* Golden Spur, collected Truro, 17 April 1939 (see Pl. 2, fig. 1).

PLATE 2. *Sclerotinia polyblastis* and *Sclerotinia narcissicola* n.sp.

Fig. 1. *Sclerotinia polyblastis.* Withered flower of *Narcissus* Golden Spur, collected Truro, 17 April 1940, approximately one month after flower crop had been harvested (× 2·6).

Figs. 2–8. *Sclerotinia narcissicola* sp.n.

Fig. 2. Production of conidia of *Botrytis narcissicola* by sclerotia on leaves of *Narcissus* Golden Spur (collected Scilly Isles, 1938) in flower pot, 20 January 1939 (× 3).

Fig. 3. Production of apothecia (and conidia) by sclerotia in same flower pot as Pl. 2, fig. 2, 6 March 1939 (× 5).

Fig. 4. Nine single-ascospore cultures from sclerotia on leaves of *Narcissus* Golden Spur (collected Scilly Isles 1938) isolated 8 March 1939, sixteen days' growth on malt extract agar.

Fig. 5. *Botrytis narcissicola.* Single conidium culture on potato dextrose agar, isolated 6 March 1939, from sclerotia on old leaves.

Fig. 6. *Sclerotinia narcissicola.* Single-ascospore culture on potato dextrose agar, isolated 28 March 1939 from same batch of sclerotia as Pl. 2, fig. 5.

Fig. 7. *Botrytis narcissicola*. Single-conidium isolate from grey mould on leaves of *Narcissus* Double White, Tamar Valley, 23 May 1939, culture on autoclaved *Narcissus* stem (× 2·8).

Fig. 8. *Sclerotinia narcissicola*. Single-ascospore isolate, culture on autoclaved *Narcissus* stem showing production of *Botrytis* conidiophores, similar to those in Pl. 2, fig. 7 (× 2·8).

PLATE 3. *Sclerotinia sphaerosperma* sp.n.

Fig. 1. Conidiophores on young leaf tip of *Allium triquetrum*, January 1940 (× 6·7).

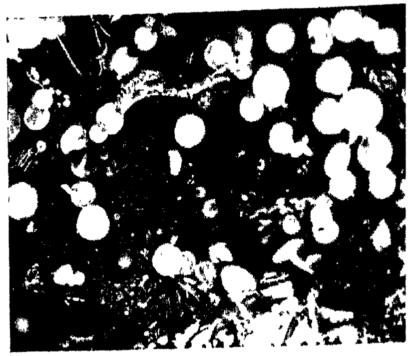
Fig. 2. Production of apothecia, January 1940, from sclerotia on aestivated leaves of *Allium triquetrum*, collected Scilly Isles May 1939 (× 4·4).

Figs. 3, 4. Spherical conidia on conidiophores of *Botrytis* type produced on leaf spots of *Allium triquetrum* (× 115 in lacto-phenol).

Fig. 5. Single-ascospore culture at six weeks on potato dextrose agar, isolated 7 December 1939, from apothecium on aestivated leaves.

Fig. 6. Single-conidium culture at six weeks on potato dextrose agar, isolated 23 May 1939 from leaf spot.

(*Accepted for publication* 9 *November* 1940)



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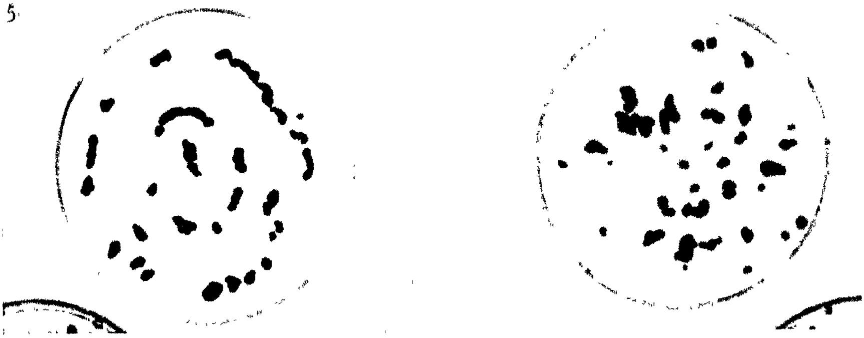

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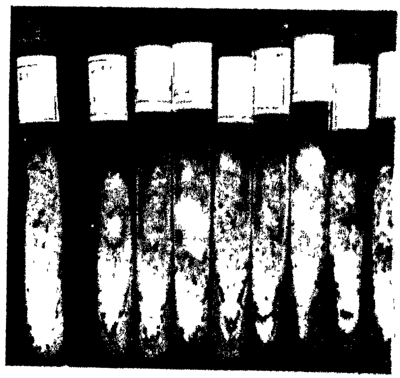

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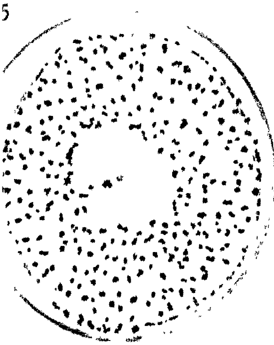

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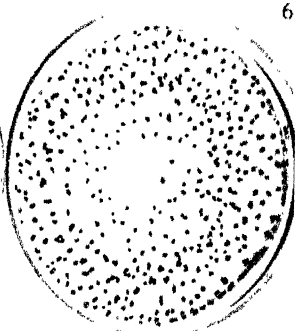

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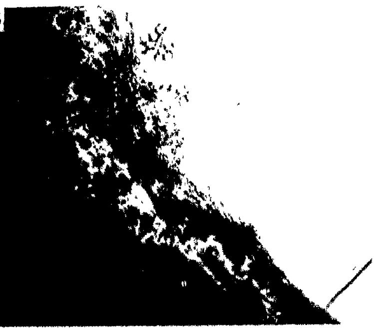

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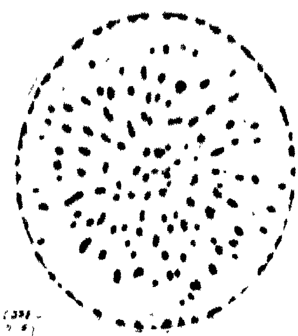

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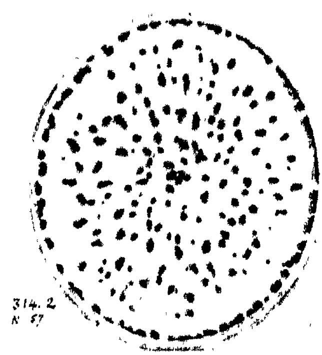


STUDIES ON BRITISH CHYTRIDS

I. *PHLYCTOCHYTRIUM PROLIFERUM* SP.NOV. AND *RHIZOPHIDIUM LECYTHII* SP.NOV.

By C. T. INGOLD

Department of Botany, University College, Leicester

(With Plate 4 and 3 Text-figures)

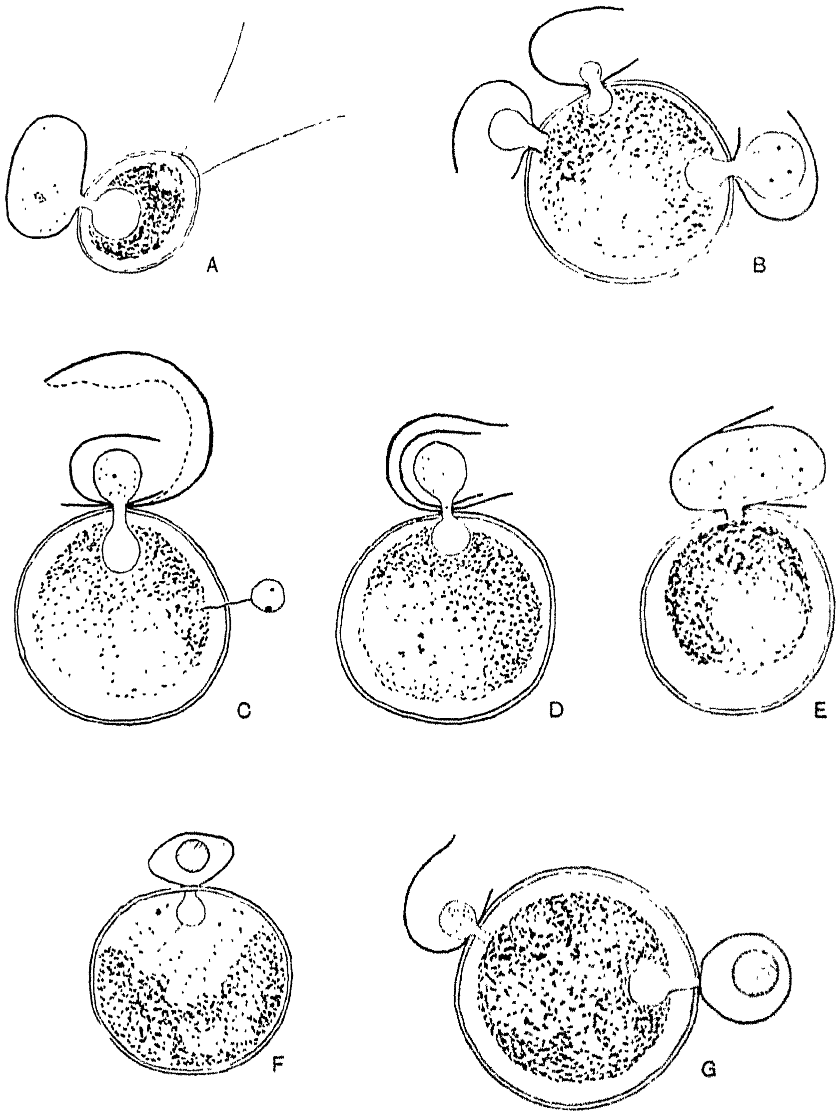
PHLYCTOCHYTRIUM PROLIFERUM SP.NOV.

This chytrid (Text-fig. 1) was found growing as a parasite on a species of *Chlamydomonas* in a temporary pond on Mortimer Common near Reading. In the sample of water from this pond which was examined *Chlamydomonas* was fairly scarce, but many of the individuals were parasitized. The fungus did not seem to produce any noticeable injury to its host, and active, swimming cells of *Chlamydomonas* were frequently seen with several of the parasites attached.

The fully grown chytrid consisted of a small spherical swelling within the host cell and an external sporangium. The wall of the swelling was very thin, and in some specimens a few extremely fine rhizoids were observed radiating from it. Occasionally, apparently because of the dense green of the host contents, it was impossible to see the intramatrical swelling (Text-fig. 1 B, E, G). The sporangium was egg-shaped with its longest axis parallel to the surface of the host.

Apparently dehiscence occurred by the solution of part of the sporangium wall, leaving a wide gaping mouth. This is shown in Text-fig. 1 C, where, besides the optical section, a higher focus (indicated by the dotted line) gives the outline of the edge of the mouth of the dehisced sporangium. The escape of spores was observed only once. The zoospores were motile, spherical, 3 μ in diameter, but unfortunately the ciliation was not observed.

The most striking feature of the fungus was the regular and constant occurrence of internal proliferation of the sporangium. An empty sporangium was never seen without a new one developing inside it (Text-fig. 1 and Pl. 4, fig. 1), although scores of sporangia from which spores had escaped were examined. In a number of examples (Text-fig. 1 C, D) the young developing sporangium was surrounded by two empty sporangia. Concentric sporangia of this type sometimes had their dehiscence pores all in the same direction (Text-fig. 1 D), but sometimes the dehiscence of the second sporangium was in the opposite direction to the first (Text-fig. 1 C). In one specimen the

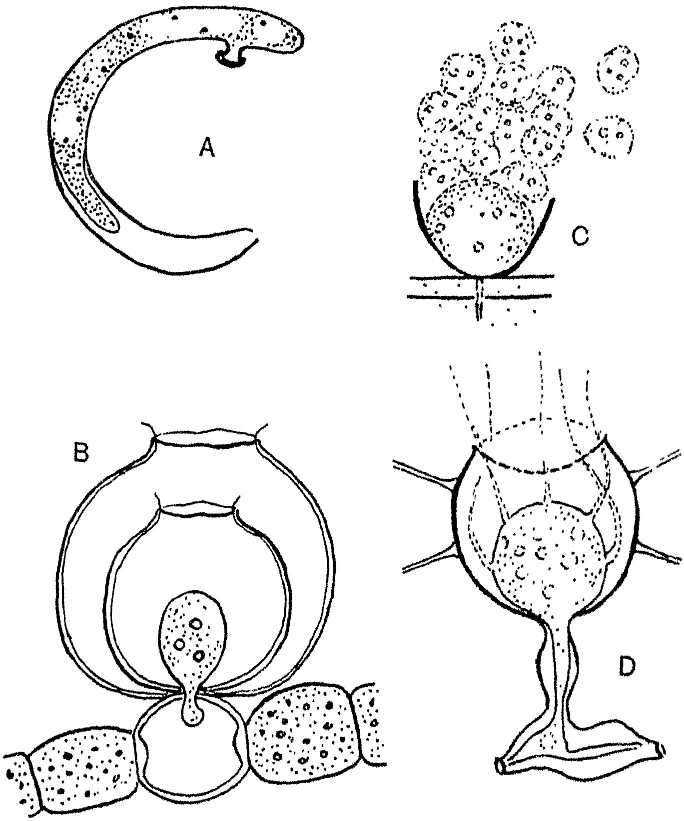


Text-fig. 1. *Phlyctochytrium proliferum* sp.nov. on *Chlamydomonas* sp. A, motile *Chlamydomonas* with the parasite. B, host cell with three parasites. Each sporangium shows internal proliferation. In one the intramatrical swelling cannot be seen. C, on the right is a very young individual. The other one is showing proliferation of the sporangium. The two empty sporangia face in opposite directions. In the outer one the edge of the mouth of the sporangium is shown by a dotted line representing a higher focus. D, chytrid with two empty sporangia which have dehisced in the same direction. E, internal proliferation with the second sporangium exceeding the first. F, resting spore. G, resting spore and sporangium attached to the same host cell Drawn with camera lucida $\times$ 1500.

second sporangium had its longitudinal axis at right angles to that of the first. Usually the sporangium of the second generation was much smaller than its predecessor, although rarely the second sporangium was as big as, or bigger, than the first (Text-fig. 1 E).

The question of internal proliferation in the monocentric chytrids of the Rhizidiaceae is interesting. Such proliferation has been observed repeatedly in *Harpochytrium Hedinii*, an organism which has been included by most workers in the Chytridiales, but now, according to Scherffel (1926) should be removed from the Fungi and regarded as an epiphytic, saprophytic alga belonging to the Xanthophyceae. In *Harpochytrium* a basal part of the sporangium does not take part in zoospore cleavage, and, after the escape of the spores, this grows to form a new sporangium. Sparrow (1936) described a chytrid, *Thraustochytrium proliferum*, in which this kind of internal proliferation occurred regularly. De Wildeman (1895) observed internal proliferation occurring frequently in his *Phlyctochytrium Spirogyrae*. Raitschenko (1902) found on *Anabaena* a chytrid which he referred to *Rhizophidium sphaerocarpum* (Zopf) Fischer. In this he described a type of internal proliferation which sometimes occurred. This seemed to be due to a zoospore remaining behind and germinating within the old sporangium to give a new individual. It is to be noted that quite empty sporangia also occurred in Raitschenko's material, although, in the German summary of his paper, he gives no indication of the frequency with which internal proliferation was observed. It is interesting that his figure should bear such a striking resemblance to my own (cf. Text-figs. 1, 2 C), but there seems no reason to doubt Raitschenko's explanation of the process in his organism. Karling (1937), for *Phlyctochytrium chaetiferum* Karling, and (1930) for *Diplophlyctis intestina* recorded zoospores remaining behind and germinating within the sporangium to produce a new individual concentric with its parent, and the question arises whether this may be the true explanation of the appearance which I have observed in *Phlyctochytrium proliferum*. It must be emphasized that I have not watched the development of successive sporangia in a single individual, and can only base my conclusions on the examination of a large number of individuals at different stages of development. The striking fact is that I have never seen an empty sporangium, since there has always been a new sporangium developing within a dehisced one. My impression is that the second sporangium is developed, as in Sparrow's *Thraustochytrium*, from a portion of the protoplasm which does not take part in the original cleavage into spores during the development of the first sporangium. However, this portion of the protoplasm which remains behind, and which gives rise to the second sporangium, may well be the equivalent of a single zoospore.

My observations on *Phlyctochytrium proliferum* were made on one small sample of pond water which I kept in the laboratory for several days. Towards the end of this time resting spores made their



Text-fig. 2. Examples of internal proliferation. A, *Harpochytrium Hedinii* Wille. It is attached to the filament of *Spirogyra* (not figured) by the lateral holdfast disk. A new sporangium is developing within the old empty one. × 1050 (original). B, *Rhizophidium sphaerocarpum* (Zopf) Fischer on *Anabaena*. × 600 (after Raitschenko, 1902). C, *Thraustochytrium proliferum* Sparrow on *Bryopsis plumosa*. The non-motile spores are escaping from the open sporangium. The protoplasm remaining at the base gives rise to a new sporangium. × 1520 (after Sparrow, 1936). D, *Phlyctochytrium chaetiferum* Karling. Internal proliferation due to a zoospore remaining behind and germinating within the old sporangium. The sporangium is extramatrical. The rest is within the cell of *Hydrodictyon* (not shown). The rhizoidal system is omitted. Highly magnified (after Karling).

appearance. The resting spore (Text-fig. 1 F, G) was extramatrical, and, although not noticeably thick-walled, had a highly refractive wall. The spore contained a single oil droplet which gave a pale

brownish colour to the whole spore. Germination of this spore was not observed.

The following is a description of the species suggested:

Phlyctochytrium proliferum sp.nov.

Sporangium ovoid, 10–15 × 6–10 μ, with the longitudinal axis parallel to the surface of the host cell. Sporangium dehiscing by large lateral pore. Zoospores spherical, 3 μ in diameter, uniguttulate. New sporangia formed by a process of internal proliferation. Intramatrical part spherical or sub-spherical, 3–5 μ in diameter. Resting spores spherical or ovoid, 8 μ in diameter, smooth-walled, extramatrical, with a single conspicuous oil drop. Parasitic on living *Chlamydomonas*.

Phlyctochytrium proliferum sp.nov.

Sporangium ovoideum, 10–15 μ long., 6–10 μ diam., axe longitudinali parallelo ad superficiem cellulae matricis. Sporangium dehiscens poro magno laterali. Zoosporae globosae, 3 μ dia., uniguttulatae. Nova sporangia ratione proliferationis internae formata. Intramatricalis pars globosa vel subglobosa, 3–5 μ dia. Sporae perdurantes globosae vel ovoidae, 8 μ dia., parietibus glabribus, extramatricales, una insigni gutta olei. *Hab.* ad *Chlamydomonas* vividam.

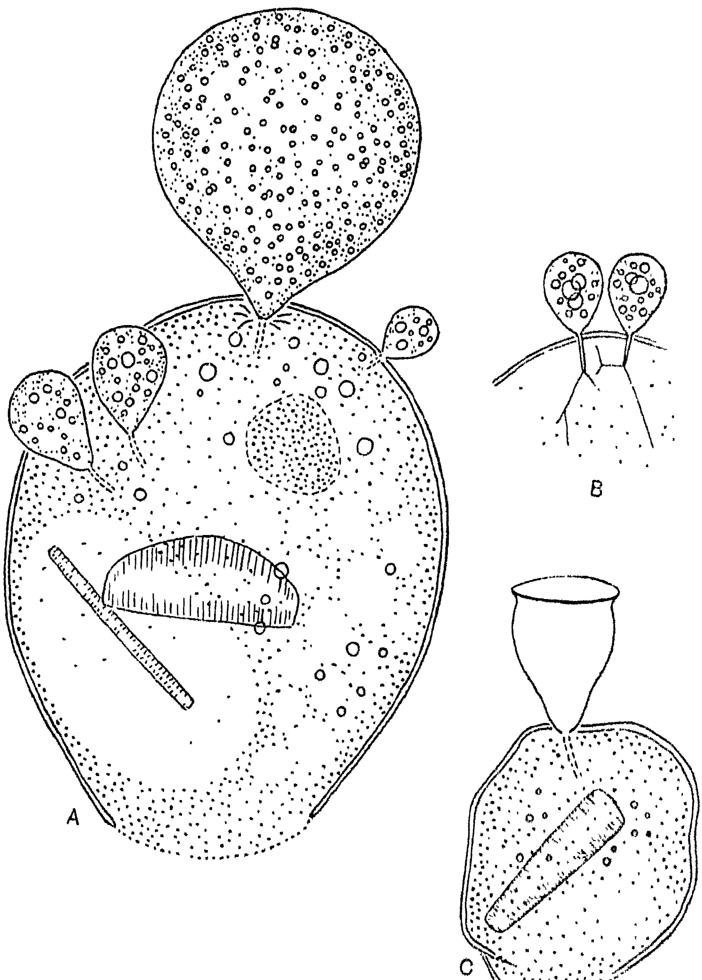
RHIZOPHIDIUM LECYTHII SP.NOV.

This chytrid was found parasitizing the rhizopod *Lecythium hyalinum* in a sample of water and algae collected at Cropston in Leicestershire from the stream which drains Cropston Reservoir. *L. hyalinum* is one of the rhizopods with a "shell" covering the protoplast except at one end where the fine pointed pseudopodia protrude. When mounted under a coverslip the pseudopodia are frequently withdrawn, and the protoplasm at the open end of the cell takes on a smooth outline (Text-fig. 3), or sometimes some of the protoplasm flows out to form a spherical globule (Pl. 4, fig. 2) still retaining, however, connexion with the protoplasm within the shell. This appears to be the characteristic behaviour of *L. hyalinum* under anaerobic conditions. Inside the rhizopod there usually occur several ingested algae, principally diatoms.

In the material which I examined, nearly all the specimens of the rhizopod were attacked by a chytrid, but in spite of this they remained not only alive but also active. An individual was often seen creeping about with ten or more chytrids on it.

In *Rhizophidium Lecythii* the mature sporangium was pear-shaped with the narrow end attached to the shell of the rhizopod. The size varied considerably from 20 to 40 μ high by 16 to 32 μ broad. From

the base of the sporangium a relatively thick and straight rhizoid penetrated the shell, and passed into the protoplasm of the rhizopod cell. From the end of this main rhizoid fine branched rhizoids rami-



Text-fig. 3. *Rhizophidium Lecythii* sp.nov. on *Lecythium hyalinum*. A, living rhizopod with four sporangia of the chytrid attached. The largest sporangium is almost mature. The main rhizoid only, indicated by dotted outline, can be seen within the host. B, two developing individuals of the fungus showing the intramatrical rhizoidal system. C, empty sporangium. All drawn with camera lucida from living material. × 1070.

fied in the protoplasm. In living material it was usually impossible to see these fine rhizoids, but in material which has been pickled for some time in formalin these are clearly visible.

Dehiscence of the sporangium and the escape of spores was not observed. Many empty sporangia were, however, seen, and these were of a highly characteristic form being vase-shaped with a wide apical opening (Text-fig. 3 C and Pl. 4, fig. 5).

This chytrid appears to be a new species. It resembles most closely *Rhizophidium echinatum* (Dang.) Fischer which was described by Dangeard (1888) as a parasite of the peridinian *Glenodinium cinctum*. *Rhizophidium Lecythii* agrees with *R. echinatum* in the pyriform shape of the sporangium, but the sporangium of the latter is much smaller (10–13 μ in length) and more triangular in longitudinal section. Again the general form of the empty sporangia is much the same in the two organisms. In *R. echinatum* a straight unbranched rhizoid occurred, while in the chytrid on *Lecythium* there was a branched system of fine rhizoids springing from the straight main rhizoid. This difference cannot, however, be stressed, since a fine rhizoidal system is easily overlooked. Finally *Rhizophidium echinatum* was chiefly distinguished by its spinous resting-spore, while in *R. Lecythii* resting spores have not been observed. *R. Lecythii* also shows a certain resemblance, both in the shape of the sporangium and in the form of the empty sporangium, to *R. clinopus* described by Scherffel (1931) who found the chytrid growing on various species of diatoms.

It seems desirable to regard the chytrid on *Lecythium* as a new species with the following description:

Rhizophidium Lecythii sp.nov.

Sporangium pear-shaped or top-shaped, 20–40 × 16–32 μ, dehiscing by a large apical pore. Empty sporangium vase-shaped. Intramatrical rhizoidal system consisting of a stout straight part with fine rhizoids branching from its tip. Resting spores not observed. Parasitic on living individuals of the rhizopod *Lecythium hyalinum*.

Rhizophidium Lecythii sp.nov.

Sporangium piriformium vel forma turbonis, 20–40 μ long., 16–32 μ dia., dehiscens poro magno apicalie. Sporangium inane forma vasis. Systema intramatricale rhizoideum crassa recta parte et rhizoidibus tenuibus tendentibus a fine rectae partis. Sporae perdurantes non observatae. *Hab.* ad *Lecythium hyalinum*.

My thanks are due to Dr F. K. Sparrow for valuable suggestions, to Miss W. Pennington who sent me the material of *Phlyctochytrium proliferum* and to Mr P. Leon for assistance with the Latin diagnoses.

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EXPLANATION OF PLATE 4

Fig. 1. *Phlyctochytrium proliferum* sp.nov. on *Chlamydomonas*. Four chytrids each with an outer empty sporangium and a new one developing within. Photographed from fresh material. × 1140.

Fig. 2. *Rhizophidium Lecythii* sp.nov. Very young stages (spherical encysted zoospores) and pear-shaped young sporangia on the shell of *Lecythium hyalinum*. Some of the protoplasm of the rhizopod has oozed out through the open end forming a globule of naked protoplasm. Photographed from living material. × 875.

Fig. 3. Rhizopod with a mature sporangium of the chytrid on it. The zoospores are delimited. Stained in iodine. × 1250.

Fig. 4. Nearly mature zoosporangium of *Rhizophidium Lecythii* and another smaller one out of focus. The protoplasm of the sporangium has retracted from its wall. The nucleus of the rhizopod is clearly visible. Photographed from material pickled in formalin. × 750.

Fig. 5. Portion of a cell of *Lecythium* with three empty sporangia of *R. Lecythii* showing the characteristic vase-shaped form. Photographed from material pickled in formalin. × 714.

(*Accepted for publication 30 December 1940*)

Fig. 1

Fig. 2

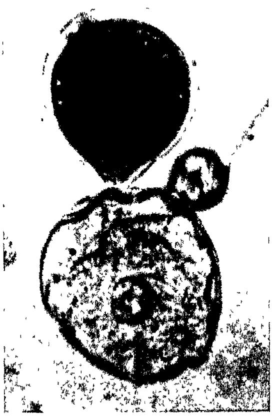

Fig. 4

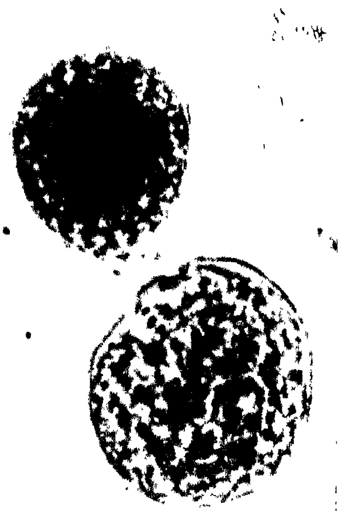

Fig. 3

Fig. 5

LIST OF HYPHOMYCETES RECORDED FOR BRITAIN

By E. M. WAKEFIELD and G. R. BISBY

Introduction

This is the third list of British Fungi compiled under the plan explained in these *Transactions*, XXIV, 126, 1940.

Most modern mycologists follow the well-known classification of the Hyphomycetes presented by Saccardo in *Sylloge Fungorum*, IV, 1886. Time certainly has not lessened the necessity recognized by Saccardo (p. 1) that a species must be sought patiently in many genera.

The difficulties of Saccardo's classification are increased when mycologists try to identify fungi growing on agar-agar and similar culture media. It is frequently difficult or impossible to decide whether a fungus on agar belongs to the Micronemeae or Macronemeae, to the Mucedinaceae (Moniliaceae) or Stilbaceae, etc. Furthermore, since agar has no 'cuticle', one of the Melanconiales in culture will appear to be one of the Tuberculariaceae or even one of the Mucedinaceae or Dematiaceae. Indeed, one frequently obtains, from a single conidium or ascospore, cultures apparently belonging to two or more genera of Hyphomycetes.

Important contributions toward an improved classification of the Hyphomycetes have been published by French mycologists. Costantin in *Les Mucédinées Simples* (1888) presented an independent classification of the fungi included by Saccardo as Mucedineae and Dematieae. Fourteen groups were keyed out on various characters, including the following: conidia or chains of conidia restricted to a special part of the conidiophore or not, conidia enveloped in mucilage or not, repent or erect conidiophores, simple or branched conidiophores, one or many conidia (or chains) at the apex, etc. Costantin grew these fungi in artificial culture whenever possible.

Bainier, from the time of Costantin's monograph until about 1910, published a long series of papers describing Hyphomycetes in culture, and a number of doctor's theses in France were devoted to various genera.

Vuillemin, especially in 1910–11, reconsidered the classification of the Hyphomycetes, pointed out clearly the methods by which chains of conidia may arise, classified the kinds of spores produced by Hyphomycetes, and differentiated the phialide.

Most mycologists outside France have followed Saccardo. Pound & Clements (*Minnesota Bot. Studies*, I, 644–73, 1896, 726–38, 1897) criticized some of the differential characters used by Saccardo, such as those based on septation and colour of spores, and proposed a modified classification which, however, has not been followed by these authors or others.

In recent years E. W. Mason (*Annotated Accounts of Fungi received at the Imperial Mycological Institute*) has attempted to apply the more exact knowledge of the Hyphomycetes, especially that of the French mycologists. He (op. cit., List II, Fascicle 3—General Part, pp. 68–99, 1937) has pointed out that these fungi may properly be divided into two main or 'natural' groups, one with moist or slimy spores, one with dry spores; that the appearance of the conidiophore differs according to the slimy or dry character of the spores, i.e. according to the way they are freed from their points of attachment; and that the method of dispersal depends largely upon this spore-character, since spores, like seeds and pollen grains of higher plants, are adapted for dispersal (1) by water, by adhering to insects, adjacent plants, etc., or (2) by wind.

We consider Mason's distinctions of fundamental importance for students of Hyphomycetes, and have made moist spores versus dry spores the primary differentiating character. For these groups two terms are now proposed:

(1) GLOIOSPORAE, Hyphomycetes with slimy spores, that is, with spores that are freed from protoplasmic contact with the parent hyphae by slime, moisture or mucilage, which is secreted by these hyphae. This more or less mucilaginous slime usually holds several or many spores in one cluster or false head. The latter may be carried away as a whole by contact with a foreign body, or the individual spores may become separated by rain or dew. Some transitional members of the Gloiosporae may produce spores first in chains, which later 'slime down' into clusters.

(2) XEROSPORAE, Hyphomycetes with dry spores, i.e. with spores that are free to be carried away by the wind when they become cut off from their parent hyphae. The spores may be formed singly or in chains. The Xerosporae may of course have their spores disseminated by water as well as by wind, but water or slime secreted by the sporogenous hyphae is not a factor in dispersal.

We have had difficulty in deciding whether certain genera belong to the Gloiosporae or the Xerosporae, since mycologists frequently omit any reference to the method by which the spores are freed, or place a dry-spored species in a genus characterized by slimy spores, and vice versa. Also, of course, Nature presents us with the expected intermediate forms.

The advantage of having considerable stretches of alphabetical

arrangement has been maintained in this list by dividing each of these main groups into only Amerosporae, Didymosporae, Phragmosporae (including Scolecosporae, for this implied distinction frequently does not hold); there are also Dictyosporae, Helicosporae, and Staurosporae amongst the British Xerosporae and a group of Endosporae placed in the Gloiosporae. The Mycelia Sterilia follow, then a few records in excluded, unknown, or uncertain genera. Dermatophytes and conidial stages of Powdery Mildews are omitted.

The grouping here used has been tested for three years for the specimens of Hyphomycetes in the Herbarium of the Imperial Mycological Institute. Related genera are more likely to be placed near together by this arrangement. The 'ideal' classification, down to genera, has still to appear. The slowly accumulating knowledge of the life histories of Ascomycetes will be included in it.

Three-fourths of the British Hyphomycetes belong to the Xerosporae. No Coelomycete is known to produce dry-spores, except *Coryneum*, which should be removed to the Hyphomycetes. There is no sharp dividing line between the Gloiosporae and Melanconiales (see Mason, loc. cit. and **29**, 196).

A century ago Berkeley (**20**) included as British just over a hundred fungi now classed as Hyphomycetes. Cooke (**15**) had about 300 in 1871, several of which were already attributed to Ascomycetes by the Tulasnes (**114**) and others.

In 1893 Massee (**8**), in the last 'complete' list of British species, described 624 entries. Then, as now, mycologists hoped that the Fungi Imperfecti would gradually disappear as a taxonomic group by becoming attached to Ascomycetes. But we still know few of the perfect stages of the 1208 Hyphomycetes that have been recorded in Britain up to date, and feel quite sure that many of them seldom or never produce such stages.

Berkeley (**18**) in 1860 again listed British Hyphomycetes, as did Cooke (with localities) in a series of reports in **14** (XVI–XVII). We have omitted references to these two lists unless they provide a first record. We have also omitted reference to numerous county or local lists unless a record seems worthy of mention, but have usually cited Stevenson's list (**13**) for Scotland, an Irish record (see list and references in **71** (XXVIII, 120–66, 1910), and the Yorkshire lists (**7**, with references up to 1905; **35**, 1905–38). Hyphomycetes recorded on Forays of the British Mycological Society are noted only when new or rare. It has seemed unnecessary to compile a complete list of Foray records.

The use of the words 'in', 'apud', 'as', 'ex', and 'gen.nov.' is usually self-explanatory; or see **28** (XXIV, 129). An asterisk (*) indicates figures drawn from British specimens, as does 't.', referring to a plate.

The citation of authors for accepted names is made to conform to the Rule that the Nomenclature of Hyphomycetes starts with Fries's *Systema Mycologicum*. The date for most species is 1832 (*Systema*, III, Sect. 2), but for some the date is 1829 (ibid. III, Sect. 1) or 1822 (ibid. II, Sect. 1). Several early names not accepted by Fries subsequently came into general use. The citation of authors for such names presents the inevitable difficulty. It is here assumed that any pre-Friesian name 'revived' in Wallroth, *Flora Crypt. Germania*, II, 1833, was there used first after Fries, and is cited, e.g. 'Pers. ex Wallr.' If not in Wallroth but in Chevallier, *Flore générale des environs de Paris*, 2nd ed. 1836, the citation is given 'Pers. ex Chev.' If in neither publication, the earliest citation found is used with a query, e.g. 'Pers. ex Sacc.?'

Records and names of British Hyphomycetes have accumulated for a century and a half; yet many 'species' are represented by but one collection or record. Most genera need comprehensive study, such as has recently been given to *Tubercularia*. British mycologists before 1890 gave little attention to parasitic Hyphomycetes, but combed the woods and fields for saprophytes. Until the microscope came to be used in identifying fungi about a century ago the Mycelia Sterilia were deemed important, but now are usually ignored, and we have not attempted to include all the older records of Mycelia Sterilia.

The compilers of this list are very grateful to those members of the Committee and others who have helped search the literature, and to Mr E. W. Mason for much help from his knowledge of Hyphomycetes.

The Hyphomycetes are now listed as follows:

		No.	Page
Gloiosporae:	Amerosporae	218	53
	Endosporae	8	62
	Didymosporae	1	63
	Phragmosporae	65	63
Incertae:	Amerosporae	3	67
Xerosporae:	Amerosporae	428	67
	Didymosporae	79	84
	Phragmosporae	255	87
	Dictyosporae	84	97
	Helicosporae	10	101
	Staurosporae	8	101
Mycelia Sterilia		39	101
[Excluded, 15]; Doubtful		10	103
	Total	1208	

LIST OF SPECIES

GLOIOSPORAE—AMEROSPORAE

The first two entries represent fungi characterized by slime-spores budded from cells of the hyphae. *Candida* and certain other Dermatophytes are similar. The spores have been called 'slimy radula spores', but we have no good name for the group. Yeasts differ in lacking true mycelium.

Polyspora Lini Lafferty gen.nov. in **70** (1921, 258*); **1** (II, 206). Described as one of the Melanconiales, but grows as a Hyphomycete similar to *Pullularia*. On *Linum usitatissimum*.

Pullularia pullulans (de Bary) Berkhout. **34** (XXVI, 630, on *Lolium*); *J. Oil Col. Chem. Ass.* XXII, 184. As *Dematium*: **66** (1892, 125); **67** (L, 261); **28** (IX, 100); **79** (X, 39; XI, 55); **34** (XV, 371, 1928) with description of the perfect stage *Anthostomella pullulans* Bennett. A common saprophyte.

Acrostalagmus albus Preuss. **27** (XXXV, 8, 1897); **28** (I, 71; VI, 87 and 156; X, 174); **34** (XVII, 289). On old plants.

— **cinnabarinus** Corda. **15**, 635*; **13**, 292; **8**, 331; **27** (XXXV, 8); **7**, 334; **33** (XVI, 82); **28** (VIII, 115; IX, 174); **34** (XV, 96; XVII, 288); **75** (XXII, 123); **70** (XIX, 562); **116**, 145; Vize Exs. 82. A common saprophyte; the perfect stage *Nectria inventa* Pethybr. in **28** (VI, 107*, 1920) is rarely found; **28** (XXI, 257).

Cooke and others at first followed Corda, who interpreted the heads of slime-spores as sporangia.—Berkeley, **20**, 343, 1836 recorded *Botrytis lateritia* Fr.; **19**, No. 238; Berk. Exs. 98; in **18**, 408 he stated '*Verticillium lateritium* is a form of this [*A. cinnabarinus*] with naked spores'. Cooke **15**, 635 cited '*Verticillium lateritium.—Botrytis lateritia*, Berk. exs. no. 98' as 'conidia' of *A. cinnabarinus*; then came the citation '*V. lateritium* Berk.': Sacc. IV, 156; **8**, 330; **33** (XVI, 82); **28** (VIII, 113; XIX, 146); **27** (L, 14); **66** (CXCVII B, 7); **75** (XII, 489); **23** (XX, 799).

— **galeoides** A. L. Smith in **28** (II, 167, 1907); Sacc. XXII, 1304. On old *Pteridium*, Epping Forest.

Amblyosporium Botrytis Fres. **14** (XVI, 59); **28** (XVIII, 14). As *A. umbellatum* Harz: **14** (XIII, 51, 1884); **8**, 299*. On Agarics.

Cephalosporium Acremonium Corda. **27** (XXIII, 164*, 1885); **14** (XIV, 133); **8**, 292*; **28** (II, 12 and 74; VI, 14 and 87); **68** (1901, 615); **7**, 329; **102** (XII, 56); **34** (XVII, 288); Mason, *Annotated Acc.* List II, Fasc. 1, p. 31. On plants and in soil. See *Volutella roseola*.

— **coccidicola** Guég. *J. Oil Col. Chem. Ass.* XXII, 184, 1939. From rain water, Wales. Doubtful; see **28** (X, 162).

— **coccorum** Petch in **28** (X, 175*, 1925); **28** (XVII, 174; XX, 12). On insects. *C. coccorum* was transferred to *Verticillium* by Westerdijk.

— **Costantinii** F. E. V. Smith in **28** (X, 90*, 1924); **112**, 329. Parasitic on cultivated mushrooms, England.

— **dipterigenum** Petch in **35** (1931, 102); **28** (XVII, 174). On a fly, Yorks.

— **Eriophytis** (Massee) Petch in **28** (XVI, 66, 1931); **28** (XVII, 174); *Botrytis 'Eriophyes'* Massee apud Taylor in **74** (IV, 5*, 1909); *Verticillium Eriophytis* (Massee) Sacc. & Trott. in *Syll.* XXII, 1299. On *Eriophyes ribis* in 'big-bud' of *Ribes*.

— **humicola** Oudem. **34** (XVII, 295*, 1930). From soil, but considered a form of *C. Acremonium*.

An asterisk indicates a figure or figures drawn from British material. The figure is not necessarily on the page indicated by the asterisk. See **28** (XXIV, 127) for other explanatory details which apply here also.

Cephalosporium lamellicola F. E. V. Smith in **28** (x, 93*, 1924); **112**, 329. Parasitic on cultivated mushrooms, England.

— **Lefroyi** Horne in **31** (3, LVII, 139, 1915); **28** (v, 241; x, 175; XVII, 174). On *Aleurodes*, Wisley.

— **macrocarpum** Corda. Listed **48** (II, 259, 1893). Ireland.

— **Malorum** Kidd & Beaumont in **28** (x, 110, 1924). On apple fruits.

— **muscarium** Petch in **35** (1931, 102); **35** (1932, 168); **28** (XVII, 174; XIX, 8). On flies.

— **succineum** Massee & Salm. in **33** (XVI, 79*, 1902); Sacc. XVIII, 512. On sheep dung, Surrey.

— **verticicola** Petch in **35** (1931, 103); **28** (XVII, 1); **35** (1936, 275). On Myxomycetes.

— sp., stage of *Cordyceps militaris*. Petch **28** (XXI, 296).

Chaetospermum chaetosporum (Pat.) A. L. Smith & Ramsb. in **28** (IV, 328, 1914). On old leaves.

Chaetostroma atrum Sacc. **37** (1909, 376). On *Cladrastis*, Kew.

— **fimicola** Massee & Salm. in **33** (XVI, 87*, 1902); Sacc. XVIII, 683. On rabbit dung, Surrey.

— **Holoschoeni** Pass. **27** (LXX, 37*, 1932). On old *Scirpus*.

Clonostachys Araucaria Corda. **68**A (v, 126, 1857); **15**, 616*; **14** (XVI, 63); **8**, 331*; **27** (XXV, 8); **28** (III, 128); **71** (XXVIII, 149). On bark and wood.

— **dichotoma** Bayliss Elliott in **28** (VI, 56*, 1918); Sacc. XXV, 710. On wood, Warwicks.

— **Simmonsii** Massee in **37** (1907, 242*); Sacc. XXV, 710; **28** (III, 35). On excrement of caterpillar, Kew.

Corethropsis epimyces Massee in **68** (2, v, 759*, 1885); Sacc. x, 523; **7**, 330. On old *Mycena*, Yorks.

— **paradoxa** Corda. **68** (1885, 759*); **7**, 330. On an old shoe, Yorks.

Cylindrocolla Urticae (Pers. ex Fr.) Bon. **14** (XVII, 13); **8**, 472*; **7**, 348; **70** (1936, 417). *Fusarium tremelloides* Grev. in **39**, t. 10, 1823; **50**, 471; **20**, 355; **15**, 559 and 704; Baxter Exs. 50; Berk. Exs. 103; Cooke Exs. 343 and II, No. 536. On *Urtica*, said to be a stage of *Calloria fusarioides*.

Dendrodochium affine Sacc. **8**, 466*, 1893. On dead stems.

— **album** Bayliss Elliott in **28** (VI, 57*, 1918); Sacc. XXV, 947. On fallen pine-cones, Warwicks.

— **citrinum** Grove in Sacc., *Syll.* IV, 652; **27** (XXIV, 206*); **14** (XVII, 12); **8**, 466; **28** (VI, 87; XVI, 5). On wood.

— **epistroma** von Höhnel. **28** (XXI, 260, 1938). On *Diatrypella*. The conidial stage of *Nectria Magnusiana* Rehm.

— **rubellum** Sacc. Listed **71** (XXVIII, 150, 1910). Ireland.

— **rubellum** var. **Brassicae** Sacc. **28** (XXIV, 53). On *Anthriscus*, Suffolk.

Dendrostilbella glabrovirens A. L. Smith & Ramsb. in **28** (v, 243, 1916); Sacc. XXV, 922. On wood, Wales, associated with *Corynella*.

Gliocladium agaricinum Cooke & Massee in **14** (XVII, 80, 1889); Sacc. x, 528; **89**, 107; **5**, 465. On cultivated mushrooms. Petch **28** (XXII, 263) finds it apparently not a *Gliocladium*. See Petch, loc. cit., and Matruchot, *Rev. gén. Bot.* VII, 327, 1895 on *Gliocladium*.

— **album** (Preuss) Petch in **28** (XXII, 261, 1939). As *G. penicillioides*: **28** (XVI, 5; XX, 4). On Myxomycetes.

— **caespitosum** Petch in **28** (XXII, 262, 1939). On *Nectria*, Yorks.

— **luteolum** von Höhnel. **70** (XIX, 557*, 1930). In butter, Ireland.

— **macropodinum** Marchal. **28** (XXII, 258). As *G. penicillioides*: **33** (XV, 331*, 1901). On dung of kangaroo, horse, and fowl, Kew, with *Eurotium insigne*.

— **penicillioides** Corda. **27** (XXIII, 165*, 1885); **14** (x, t. 156; XIV, 133); **8**, 293; **28** (XXI, 272; XXII, 260). *G. lignicola* Grove in **27** (XXIV, 199); Sacc. x, 528; **8**, 294; **7**, 329. *Verticillium Aspergillus* B. & Br. in **19** (4, XI, 346*, No. 1384, 1873); **14** (II, 139); **8**, 329. On Thelephoraceae and Polyporaceae, 'most probably the conidial stage of *Hypomyces aureonitens*'. Petch points out that

Penicillium socium Sacc. and *P. Hypomycetis* Sacc. are meaningless names based on an inaccurate figure.

Gliocladium roseum (Link ex Fr.) Bainier. As *Penicillium*: **19** (2, VII, 102, No. 535, 1851); **18**, 350; **14** (XVI, 60); **8**, 303; **116**, 107; *Proc. Birmingham Nat. Hist. Phil. Soc.* XVI, 93; Vize Exs. 339. On old plants. Cooke **15**, 602 and **59** (1871) considered *P. roseum* 'an imperfect condition of *Mucor hyalinus*'; Cooke Exs. II, No. 344. Saccardo, *Syll.* IV, 155, called this *Penicillium roseum* 'Cooke, nec Link' and referred it to *Verticillium Buxi*, but Massee **8**, 330 did not agree.

— **strictum** Petch in **28** (XXI, 301, 1938). On *Fomes*; a stage of *Hypomyces Broomeanus*. *Verticillium microspermum* Sacc. is based on an erroneous figure by Cooke in **14** (XI, 48*, 1882); see Petch, **28** (XXII, 262).

Gliomastix chartarum (Link ex Fr.) Guég. As *Oidium*: **19** (1, I, 263, No. 130, 1838); **15**, 603; **40** (VIII, 228); Vize Exs. 571. As *Torula*: **8**, 363; **116**, 148; Vize Exs. 318. On paper. Guéguen may not have had Link's species.

— **convoluta** (Harz) Mason in *Annotated Acc.* 1941. As *Torula*: **28** (VI, 157, 1919); **22** (Misc. Publ. 23, p. 27); **70** (1936, 416); **115**, 99. On potato tubers, etc.

— **convoluta** var. **felina** (Marchal) Mason, loc. cit. As *Periconia felina* March: **34** (XVII, 293*, 1930). *Graphium Malorum* Kidd & Beaumont in **28** (X, 113, 1924). In soil and apples.

Gonytrichum caesium Nees ex Wallr. **18**, 353; **15**, 613; **8**, 387*; **28** (II, 56); **35** (1909, 320); Berk. **20**, 335, 1836 as *Myxotrichum*. On wood. See **102** (XVII, 121).

— **fuscum** Corda. **19** (3, XV, 402, No. 1054, 1865); **15**, 613*; Cooke Exs. 348; Vize Exs. 338. On wood.

Graphium anomalum (Berk.) Sacc. in *Syll.* IV, 618; **8**, 457: *Stilbum* Berk. in **19** (1, 49*, No. 34, 1837); **18**, 340; **15**, 554. On *Hypnum* on wood, King's Cliffe.

— **bicolor** (Pers. ex Fr.) Sacc. **14** (XVII, 11); **8**, 457. As *Stilbum*: Berk. **20**, 330, 1836; **19** (4, VII, 431, No. 1310); **15**, 554; **13**, 265. As *Stilbella*: **71** (XXVIII, 150). On wood.

— **calicioides** Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 695; **14** (XVII, 10). On wood, said to be 'part of *Periconia calycioides* of Berkeley', q.v. under *Sporocybe*.

— **comatrichoides** Massee & Salm. in **33** (XVI, 88*, 1902); Sacc. XVIII, 649. On dung of llama, Kew.

[— **fissum** Preuss. See *Phaeoisaria* in Xerosporae—Amerosporae.]

— **flexuosum** (Massee) Sacc. in *Syll.* IV, 611; **8**, 455; **7**, 346; *Stilbum* Massee in **68** (2, V, 758*, 1885). On wood, Yorks. See *G. rigidum*.

— **glaucocephalum** (Corda) Sacc. **8**, 456; **7**, 346. As *Periconia*: Berk. **19** (2, V, 465, No. 495, 1850); **18**, 343; **15**, 565*. On old cloth and herbs.

— **graminum** Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 695; **8**, 457. On *Gynerium*, Kew.

— **griseum** (Berk.) Sacc. in *Syll.* IV, 616; **8**, 456; **35** (1912, 92). *Pachnocybe* Berk. in **20**, 334, 1836; **19** (2, V, 465, No. 495); **15**, 551; **13**, 264. On stems.

— **Grovei** Sacc. in *Syll.* IV, 613; **14** (XVII, 11); **8**, 455; **71** (XXVIII, 150); **35** (1913, 177). *Pachnocybe clavulata* Grove in **27** (XXIII, 168*, 1885); **14** (XIV, 133). On wood.

— **nigrum** (Berk.) Sacc. in *Syll.* IV, 617; **14** (XVII, 11); **8**, 457. *Stilbum* Berk. in **20**, 330, 1836; **18**, 340; **15**, 554. On old *Eriophorum*, Hunts.

— **Passerinii** Sacc. **8**, 455, 1893; **27** (L, 46); **28** (IV, 184). On dry *Rubus*.

— **penicillioides** Corda. **27** (XXIV, 205, 1886); **8**, 457. On bark; reported **70** (XIX, 558*) in butter. A stage of *Ophiostoma Piceae*; see **28** (VII, 234*), Mason, *Annotated Acc.* 1937, 91, and *Leptographium Lundbergii*.

— **piliforme** (Pers. ex Fr.) Sacc. **8**, 456. As *Stilbum*: **120**, 563, 1821; **19** (1, 49, No. 33, 1837); **15**, 554; Berk. Exs. 50. On wood and herbs.

— **rigidum** (Pers. ex Fr.) Sacc. **8**, 454; **7**, 346; **28** (IX, 4). As *Stilbum*: **19** (1, 49, No. 32, 1837); **15**, 554; **13**, 265; **46** (II, 215). On wood. Phillips **14** (IV, 82*) as *S. rigidum* was apparently *G. flexuosum* (E. W. Mason in MS.).

Graphium stercorarium Marchal. **33** (XVI, 88, 1902). Developed at Kew on dung of monkey from Gold Coast. Perhaps not a British species.

— **Stevensonii** (Berk. & Br.) Sacc. in *Syll.* IV, 613; **8**, 456. *Stilbum* B. & Br. in **19** (5, I, 27, No. 1713, 1878); **14** (VI, 126); **13**, 265. On wood, Scotland.

— **stilboideum** Corda. **19** (4, VII, 432, No. 1315, 1871); **14** (I, 20); **8**, 454; **7**, 346. On stems, etc.

— **subulatum** (Nees ex Fr.) Sacc. **8**, 455*; **33** (XVI, 89); **7**, 346. *Pachnocybe* Berk. gen.nov. in **20**, 333, 1836; **18**, 339; **15**, 550*; **13**, 264; Berk. Exs. 51. *Clavaria tenuis* Sow. in **42**, t. 386, 1803. On wood, etc.

— **Ulmi** Schwarz. **31** (LXXXIII, 31*, 1928); **112**, 343; **64** (XLV, 104; XLVI, 194), **76** (VI, 125); **79** (IX, 25 and 43; XI, 59); **85** (XXIX, 16; XXXV, 22; XLI, 18); **93**, 226; **94** (XXVII, 52); **35** (1937, 287). Parasitic on *Ulmus*; a stage of *Ophiostoma Ulmi*.

— **xanthocephalum** (Ditm.) Sacc. **35** (1907, 100). In a greenhouse, Yorks.

Haplographium bicolor Grove in **27** (XXIII, 167, June 1885); **60** (Sept. 1885, 198* (and 234)); Sacc. IV, 305; **14** (XIV, 132; XVI, 99); **8**, 381; **7**, 339; Mason, *Annotated Acc.* List II, Fasc. 2, 61*. On wood.

— **delicatum** Berk. & Br. gen.nov. in **19** (3, III, 360*, No. 818, 1859); Sacc. IV, 304; **15**, 568*; **14** (XVI, 99); **46** (III, 266); **8**, 380; **7**, 339; **71** (XXVIII, 149); Mason, *Annotated Acc.* List II, Fasc. 2, 63*. On wood.

— **finitimum** (Preuss) Sacc. **28** (III, 36*, 1908; VI, 55). As *H. fuscipes* (Preuss) Sacc.: **28** (VI, 59*). On leaves and cones of pine. See von Hohnel, *Frag. Myc.* No. 89, and Melin & Nannfeldt, *Svenska Skogsvardsf. Tidskr.* 1934, 426. The figures in **28** show that the British collections belonged to the Xerosporae.

— **olivaceum** Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 588; **8**, 382*. On wood, Isleworth. Also one of the Xerosporae.

— **saponis** (Berk. & Br.) Sacc. in *Syll.* IV, 307; **14** (XVI, 99); **8**, 381. *Penicillium* B. & Br. in **19** (5, VII, 130, No. 1913, 1881); **14** (X, 50). On soap. Evidently not a *Haplographium*. No specimen known.

[— **tenuissimum** (Corda) Grove in **60** (1885, 198*), not reported for Britain; compiled as British, apparently in error, **14** (XVI, 99); **8**, 381. No specimen found in Kew Herb. Von Hohnel, *Zbl. Bakt.* LX, 10, thought it the same as *H. delicatum*.]

Hirsutella acridiorum Petch in **28** (XVII, 177, 1932). On a grasshopper, Yorks.

— **Aphidis** Petch in **35** (1936, 60). On *Aphis*.

— **dipterigena** Petch in **28** (XXI, 53, 1937). On *Diptera*.

— **Eleutheratorum** (Nees ex Fr.) Petch in **35** (1932, 46); **28** (XVII, 176); **70** (1936, 417). As *Isaria*: **120**, 563, 1821; **40** (IX, 172). On beetles.

— **exoleta** (Fr.) Petch in **35** (1936, 251); **28** (XXIII, 142). On pupae of Lepidoptera.

— **lecaniicola** (Jaap) Petch in **28** (XVIII, 53, 1933); **28** (XXI, 299). On scale insects; a stage of *Ophiocordyceps clavulata*.

— **subulata** Petch in **35** (1932, 48); **28** (XVII, 177). As '*Isaria floccosa* Fr.': **19**, No. 1906, 1881; **14** (X, 49; XVII, 9); **8**, 447. On a caterpillar, Northants.

Hyalopus albidus Kidd & Beaumont in **28** (X, 110, 1924). On apples.—*Hyalopus* is perhaps not distinct from *Cephalosporium*: see Petch, **28** (X, 165).

— **ater** Corda. **27** (XXIII, 166*, 1885); **14** (XIV, 133). On wood.

— **pruinosus** Marchal. **28** (X, 110, 1924); **34** (XII, 29). On apples.

Hymenula Berkeleyi Sacc. in *Syll.* IV, 671; **14** (XVII, 13); **8**, 471; **37** (1909, 376). *H. punctiformis* Berk. & Br. [non Corda] in **19**, No. 729, 1854; **15**, 353. On conifers.

— **callorioides** Sacc. var. **corticis** Grove in **27** (L, 46*, 1912); **28** (IV, 284). On bark, Studley Castle.

— **constellata** Berk. & Br. in **19** (4, XVII, 138, No. 1590, 1876); Sacc. IV, 670; **8**, 471. On wood.

— **herbarum** Sacc. & Roum. **7A**, 300, 1904; **7**, 348. On leaves, Yorks.

[— **pezizoides** Phill. **14** (XVII, 13). This is apparently a *nomen nudum*.]

[**Hymenula Platani** (Mont.) Lév. **14** (VIII, 111). This is *Gloeosporium Platani* (Mont.) Oudem.]
— **rubella** Fr. **14** (XVII, 13, 1888); **8**, 471. On stems.
— **vulgaris** Fr. **14** (XVII, 13, 1888); **8**, 471. On stems.
Illosporium carneum Fr. **19** (2, V, 466, No. 497, 1850); **15**, 561, **13**, 268; **8**, 468; **7**, 347; **119**, 633; Berk. Exs. 293; Cooke Exs. II, No. 535; Vize Exs. 352. On *Peltigera*, stage of *Nectriella Robergei*; see **28** (XXI, 270).
— **coccineum** Fr. **19**, No. 499, 1850; **15**, 561; **8**, 468; **119**, 633. On Lichens.
— **corallinum** Rob. **19**, No. 498, 1850; **15**, 561; **8**, 468. On Lichens. It is sometimes placed as a var. of *I. roseum*, e.g. **119**, 632.
[— **Curreyi** (Berk.) Sacc. This is *Ctenomyces serratus* Eidam, see **27** (XLII, 55).]
— **roseum** Fr. **58**, 144; **20**, 328; **15**, 560*; **13**, 267; **8**, 468*; **7**, 347; **119**, 631; Cooke Exs. II, No. 337. As *Palmella*: **39**, t. 51, 1823; **51**, 323. On lichens.
Leptographium Lundbergii Lagerberg & Melin in *Svenska Skogsvardsf. Tidskr.* 1927, 248. **28** (VII, t. 9) is considered to illustrate this species.
Menispora ciliata Corda. **15**, 614, 1871; **40** (V, 9 and 325); **48** (II, 259); **8**, 386*; **35** (1908, 411); **28** (X, 7); Vize Exs. 342. On wood.
— **lucida** Corda. **19** (2, VII, 101, No. 530, 1851); **15**, 614*, **13**, 285; **8**, 385*; **71** (XXVIII, 149). On wood.
Menoidea Abietis Mangin & Hariot. **28** (XIII, 155*, 1928). On dead leaves of *Abies*, Scotland and Isle of Man.
Myrothecium Cookei Sacc. & Syd. in *Syll.* XIV, 1129. *M. cinereum* Cooke [non Pass.] in **14** (XX, 113, 1892); Sacc. XI, 656. On *Oncidium*, Ireland.
— **inundatum** Tode ex Fr. **14** (XVII, 16, 1888); **8**, 490*; **48** (XVII, 27). On old agarics.
— **roridum** Tode ex Fr. **20**, 323, 1836; **15**, 559*; **13**, 267; **46** (IV, 148); **8**, 490; **28** (XX, 242*); **85** (XLI, 18); Cooke Exs. II, No. 628. *M. Carmichaelii* Grev. in **39**, t. 140, 1823. On old plants; parasitic on *Viola*.
Oospora abortifaciens (Quekett) Sacc. & Vogl. in *Syll.* IV, 25; **8**, 281; **28** (XIX, 146, in air). *Ergotoetia* Quekett in **45** (XVIII, 471*, 1841). *Oidium* B. & Br. in **19** (2, VII, 178, No. 545, 1851); **15**, 772. On grasses infected with *Claviceps*; some of the records probably refer to *Sphacelia segetum*.—A few of the species of *Oospora* below are Xerosporae.
— **aequivoca** (Corda) Sacc. & Vogl. **14** (XVI, 57); **8**, 278. *Oidium aequivocum* (Corda) B. & Br. in **19** (3, III, 361, No. 821, 1859); **15**, 604. On *Polyporus*, Dorset.
— **candidula** Sacc. **27** (XXIII, 163, 1885); **14** (XIV, 133); **8**, 278; **37** (1907, 242); **35** (1914, 16); **70** (1936, 410); **28** (XXIV, 55). On *Nectria* and twigs.
— **carneola** Sacc. **75** (XII, 489, 1912). On chilled meat.
— **coccinea** Sacc. & Vogl. **35** (1900, 8); **28** (I, 150); **7**, 327. On cat's dung, Yorks.
— **Cookei** Sacc. in *Syll.* X, 513. *O. inaequalis* Cooke & Massee [non (Corda) Sacc. and Vogl.] in **14** (XVI, 10, 1887); **8**, 281; **89**, 176. On bamboo, Kew.
— **equina** (Desm.) Sacc. & Vogl. **28** (IV, 327, 1914). On skin and bones of a cat, Worcester.
— **fasciculata** (Grev. ex Berk.) Sacc. & Vogl. in *Syll.* IV, 11; **8**, 277. *Acrosporium* Grev. in **51**, 469, 1824. *Oidium* Berk. in **20**, 349; **15**, 604; **13**, 280. On decaying oranges.
— **favorum** (Berk. & Br.) Sacc. & Vogl. in *Syll.* IV, 22; **8**, 279; **74** (VII, 157*). *Oidium* B. & Br. in **19**, No. 762*, 1854; **15**, 604. On honeycomb.
— **fimicola** (Cost. & Matr.) Cub. & Megl. **85** (XXVIII, 51, 1931; XXIX, 21; XXXV, 27; XXXIX, 23); **31** (3, XCVI, 444); **22** (Bull. 79, p. 92). On mushroom beds. This fungus is xerosporous.
— **fulva** (Kunze ex Fr.) Sacc. & Vogl. **8**, 280. As *Oidium*: Berk. **20**, 348, 1836; **15**, 603*; **13**, 280; Berk. Exs. 295. On decayed wood.
— **hyalinula** (Sacc.) Sacc. **27** (L, 11, 1912); **28** (XXIV, 55). On old *Fraxinus*.
— **lactis** (Fres.) Sacc. **14** (XVI, 57, 1887); **66** (1892, 125); **8**, 277; **23** (XII, 643); **103** (V, 222); **33** (XXXII, 531); **28** (IX, 171); **70** (XIX, 562). In milk, cheese, butter, and slime-flux. See *Geotrichum candidum* (p. 72).

Oospora lateritia Sacc. **28** (II, 167, 1907). On leaves, Luton.
— **Ludwigii** (Hans.) Sacc. & D. Sacc. **28** (IX, 177, 1924). In slime-flux, Cambs.
— **Mali** Kidd & Beaumont in **28** (X, 109, 1924). On apples.
— **microsperma** (Berk. & Br.) Sacc. & Vogl. in *Syll.* IV, 22; **8**, 279; **71** (XXVIII, 148); **35** (1936, 275). *Oidium* B. & Br. in **19** (4, XI, 346, No. 1387, 1873). On fir bark.
— **ochracea** (Corda) Sacc. & Vogl. **27** (L, 11, 1912); **28** (III, 367; VIII, 254). On jam, etc.
[— **porriginis** Sacc. **8**, 278; previous records as *Oidium*. This is *Achorion Schoenleini*, a Dermatophyte.]
— **pullulans** (Lindner) Lindau. Recorded **115**, 94, 1937.
[— **pulmonea** (Bennett) Sacc. See C. W. Dodge, *Medical Mycology*.]
— **pustulans** Owen & Wakefield in **37** (1919, 297*); **37** (1923, 273*); **31** (LXXIII, 355); **112**, 328; **79** (V, 28); **65** (XXX, 343); **28** (XIV, 151); **24** (XV, 191); **71** (XL B, 54); **22** (Bull. 79, p. 27); **85** (XXIX, 17); first attributed to *Spicaria Solani* Harting, **25** (XV, 524). On potato tubers, causing Skin Spot.
— **rosella** Grove in **27** (XXIII, 163, 1885); Sacc. IV, 19; **14** (XVI, 57). On horse dung, Birmingham.
[— **scabies** Thaxt. is *Actinomyces scabies*, a Schizomycete.]
— **suaveolens** (Lindner) Lindau. Recorded **115**, 94, 1937.
— **sulphurella** Sacc. & Roum. **28** (II, 167, 1907); **27** (L, 11). On bark and wood.
— **Trichiae** Petch in **35** (1936, 59). On *Trichia verrucosa*, Yorks.
— **variabilis** (Lindner) Lindau. **102** (XII, 55*, 1914); **115**, 94; **75** (XXII, 123) as *Monilia*. In soil, etc.
Scopularia venusta Preuss. **27** (LXIV, 107*, 1926). On pine cones.
Sphacelia Curreyana Grove in **27** (L, 46, 1912); Sacc. XXV, 952; **28** (IV, 184). On sclerotia of *Sclerotinia Curreyana* in *Juncus*, Warwicks. A *Sphacelia* on *Juncus* was recorded as '*Claviceps Junci*' Adams in **48** (XVI, 168*, 1907).
— **segetum** Lév. **14** (XVII, 13); **8**, 470; **28** (XXI, 300); *Farinaria Poae* Sow. in **42**, t. 396, 1803. This stage of *Claviceps purpurea* is seldom cited by name.
— **typhina** Sacc. **14** (XVII, 13, 1888); **8**, 470; **28** (XXI, 294). A stage of *Epichloe* on grasses.
Sporocybe atra (Desm.) Sacc. **14** (XVII, 10, 1888); **8**, 453. On grass.
— **Azaleae** (Peck) Sacc. **28** (XIV, 171, 1929; XV, 5); **65** (XXX, 347, 1931); **22** (Bull. 79, p. 100); **71** (XLII B, 54); **79** (XIII, 35); **93**, 197. On *Rhododendron*. See Mason, *Annotated Acc.* 1941.
— **brassicicola** (Berk. & Br.) Sacc. in *Syll.* IV, 606; **14** (XVII, 10); **8**, 453. *Periconia* B. & Br. in **19** (4, XV, 33*, No. 1452, 1875); **14** (III, 181); Cooke Exs. 647 and II, No. 165. In old cabbage stalks.
— '**byssoides** Bon.' **8**, 452*, 1893. On stems. Probably an erroneous compilation of *Periconia byssoides*.
— **calicioides** Fr. **20**, 333, 1836; **8**, 453. *Periconia calicioides* (Fr.) Berk. in **18**, 343; **15**, 565; **13**, 268; **48** (XVII, 26). On stems. Fries had an Ascomycete: see **100** (XII, 220) and *Ann. Épiphyt.* XVI, 267. Cooke & Massee proposed *Graphium calicioides* (q.v.) for part of the British records.
— **cuneifera** (Berk. & Br.) Sacc. in *Syll.* IV, 606; **14** (XVII, 10); **8**, 453. *Stilbum* B. & Br. in **19** (4, XV, 33*, No. 1451, 1875); **14** (III, 181). On old cabbage stalks, Batheaston.
— **Phillipsii** (Berk. & Leight.) Sacc. in *Syll.* IV, 609; **8**, 453; **7**, 346; *Periconia* Berk. & Leight. apud B. & Br. in **19** (4, XV, 33, No. 1453, 1875); **14** (III, 124* and 182); Cooke Exs. II, No. 166. On soil.
Stachybotrys alternans Bon. **14** (XVI, 97, 1888); **8**, 368; **27** (XXXV, 8); **28** (I, 184); **68** (1901, 615); **116**, 147. On paper, etc.—See von Höhnel, *Zbl. Bakt.* 2. Abt. LX, 14, 1923, and *Periconia* below (p. 79).
— **asperula** Massee in **14** (XVI, 26, 1887); Sacc. X, 577; **14** (XVI, 98); **8**, 369*. Kew, on paper from Ceylon. See *S. lobulata*. Petch **28** (XV, 249) redescribed the type as a Ceylon fungus.

Stachybotrys atra Corda. **19** (3, III, 360, No. 817, 1859); **15**, 567*; **48** (II, 259); **8**, 368; **7**, 337; **116**, 148; Cooke Exs. 640; Vize Exs. 350. On paper, etc.
— **dichroa** Grove in Sacc., *Syll.* IV, 270; **27** (XXIV, 201*); **8**, 368; **7**, 338. On decaying stems.
— **lobulata** (Berk.) Berk. in **18**, 343; Sacc. IV, 269; **15**, 567; **73** (1877, t. 27); **48** (II, 259); **27** (L, 16, with note that *S. asperula* is a synonym); **35** (1912, 91); *Sporocybe* Berk. in **19** (1, VI, 434*, No. 228, 1841). On damp cloth, etc.
— **verrucosa** Cooke & Massee in **14** (XVI, 102, 1888); Sacc. X, 577. On paper, Kew.
Stachylidium bicolor Link ex Fr. **120**, 553, 1821; **20**, 341; **71** (XXVIII, 149). On stems.
— **cyclosporum** Grove in **27** (XXII, 199, 1884); Sacc. IV, 332; **27** (XXIII, 167*); **8**, 387*; **48** (V, 234); **7**, 339; **37** (1911, 377). On branches, etc.
— **extorre** Sacc. **27** (XXIV, 202, 1886); **40** (IX, 172); **8**, 388; **7**, 339; var. *majus* reported **34** (XVII, 290). On wood, etc.
Stilbum acicula (Berk.) Sacc. in *Syll.* IV, 569; **14** (XVII, 9); **8**, 444; **35** (1905, 189). *Pachnocybe* Berk. in **20**, 334, 1836; **15**, 551. On stems.—*Stilbum* Tode was based on six species. The first one, *S. vulgare*, was considered by Juel to be a Basidiomycete. Lindau, *Nat. Pflanzenfam.* 1900, chose this as the type of *Stilbum*, and proposed *Stilbella* as the name for the Hyphomycete. But *Stilbum* of Fries's *Systema* is definitely a Hyphomycete.
Without attempting to decide whether *Stilbum* or *Stilbella* should now be used, we are listing the British species as *Stilbum*, for some of them have not been transferred to *Stilbella*. It should be noted, however, that Rea **2**, 728, accepted the name *Stilbum* as that of a Basidiomycete.
— **aurantiacum** Bab. ex Berk. in **19** (1, VI, 432*, No. 223, 1841) [nomen nudum Babington in *Proc. Linn. Soc. Lond.* I, 32, 1839]; Sacc. IV, 573; **15**, 553; **8**, 445; **7**, 344. *Stilbella* Lindau, 1908; **28** (XXI, 262*) as conidial stage of *Sphaerostilbe aurantiaca*. On *Ulmus*. See Wollenweber, *Fus. autogr. del.* t. 789.
— **bulbosum** Tode ex Fr. **120**, 564, 1821. On old plants.
— **citrinellum** Cooke & Massee in **14** (XVI, 81, 1888); Sacc. X, 684; **8**, 446*. On *Lycopodium*, Kew.
— **erythrocephalum** Ditm. ex Fr. **20**, 330, 1836; **15**, 553; **27** (L, 55*); **8**, 444; **33** (XVI, 86); **7**, 344. As *Stilbella*: **71** (XXVIII, 150); **35** (1937, 287). On dung of various animals.
— **fasciculatum** Berk. & Br. in **19** (2, V, 465, No. 492, 1850); Sacc. IV, 570; **19**, No. 1148; **15**, 553; **8**, 445; **7**, 344. *Stilbella* [comb.nov.?] in **115**, 103. On wood.
— **fimetarium** (Pers. ex Fr.) Berk. & Br. in **19** (2, V, 465, No. 494, 1850); **15**, 553; **48** (II, 258); **8**, 445; **7**, 344. As *Stilbella*: **35** (1937, 287). On dung.
— **Kervillei** Quél. **27** (LXIX, 205, 1931); **35** (1932, 133). As *Stilbella*: **28** (XVII, 175; XXI, 53). On *Hirsutella* on flies. Petch later, **28** (XXIII, 140), considered that *Stilbum ramosum* Peck is the earliest valid name, and that *Stilbella setiformis* (Vahl) Petch in **28** (XVIII, 55) is a synonym.
— **leiopus** Ehrenb. ex Wallr. **35** (1901, 342); **28** (I, 194); **7**, 344; **115**, 103 as *Stilbella*. On mouse dung.
— **melleum** Berk. & Br. in **19** (4, XVII, 141*, No. 1609, 1876); Sacc. IV, 565; **14** (V, 57; XVII, 8); **8**, 446. On bark.
— **nigripes** Cooke in **14** (XVI, 81, 1888); Sacc. X, 683; **14** (XVII, 9). On oak leaves, Scotland.
— **orbiculare** Berk. & Br. in **19** (5, I, 28*, No. 1714, 1878); Sacc. IV, 566; **14** (VI, 127); **13**, 265; **40** (V, 8); **8**, 443. On *Lindbladia*, Scotland.
— **pellucidum** Schrad. ex Fr. **20**, 330, 1836; **18**, 340; **15**, 555; **13**, 265; **8**, 444; **7**, 344; **35** (1937, 283) as *Stilbella*; **27** (LXXV, 226). On wood and fungi.
— **ranigenum** (Berk. & Br.) Sacc. in *Syll.* IV, 573; **14** (XVII, 9); **8**, 446 as *S.* '*ramigenum*'. *Acremonium* B. & Br. in **19** (4, VII, 432*, No. 1319, 1871); **14** (I, 21). The type and only collection is on a dead frog; later references erroneously state 'on rotten branches'.

Stilbum sphaerocephalum Massee in **37** (1907, 243*); Sacc. XXII, 1437; **28** (III, 37). On *Philodendron*, Kew.
[— **tetraonum** Cooke nomen nudum, **14** (XVII, 9). On grouse dung, Rannoch.]
— **turbinatum** Tode ex Fr. **20**, 330, 1836; **19** (4, VII, 431, No. 1310); **15**, 555; **8**, 445. On wood, etc.
— **vaporarium** Berk. & Br. in **19** (2, V, 465, No. 493, 1850); Sacc. IV, 570; **18**, 339; **15**, 553; **8**, 445. On wood in hot-houses.
[— **vulgare** Tode ex Fr. **120**, 564, 1821; **51**, 418; **20**, 330; **15**, 555*; **13**, 265; **40** (VIII, 228); **8**, 444; **7**, 344. On stems. **2**, 728, as a Basidiomycete.]
Synglioeladium aranearum Petch gen.nov. in **28** (XVII, 177, 1932). On a spider, Horsham.
Synsporium biguttatum Preuss. **102** (XII, 46*, 1914); **28** (IV, 165). In soil. See E. W. Mason, *Annotated Acc.* Fasc. II, List 3.
Tilachlidium cinnabarinum Kidd & Beaumont in **28** (X, 113, 1924). From apples.
— **subulatum** A. L. Smith in **28** (III, 122*, 1909); Sacc. XXII, 1439. On debris.
— **tomentosum** (Schrad ex Fr.) Lindau. **28** (V, 17). As *Stilbum*: **39**, t. 281, 1827; **20**, 330; **15**, 552; **13**, 264; **27** (XVII, 335); **48** (II, 258); **8**, 444; **7**, 343; Vize Exs. 354. Var. *ovalisporum* A. L. Smith in **28** (II, 26, 1903); **28** (XVI, 15). *Isaria microscopica* Grev. in **39**, t. 3, 1823; **51**, 466; **14** (XVII, 10); **8**, 449. On Myxomycetes.
Tolypomyria microsperma (Corda) Sacc. **27** (LXIV, 108*, 1926). On pine cone, Warwicks.
Trichoderma album Preuss. **102** (X, 461*, 1912); **28** (IV, 181; XXIII, 151). In soil. Evidently not a *Trichoderma*.
— **Koningi** Oudem. **102** (X, 461*, 1912); **28** (IV, 181; VI, 370; XXIII, 149); **34** (XV, 96); **82** (XIV, 43); **116**, 143. In soil, etc. Hardly distinct from *T. viride*.
— **viride** Pers. ex Fr. **42**, t. 378, 1803; **120**, 560; **39**, t. 271; **51**, 465; **20**, 323; **114** (III, 30); **15**, 774; **68** (1901, 615); **84** (III, 188); **22** (Bull. 117, p. 92); **28** (XXIII, 149*); Cooke Exs. II, No. 338. As *T. lignorum*: **8**, 295; **28** (IX, 174; XXI, 290); **66** (CXCVII B, 7; CCXX B, 99); **67** (CV B, 375; CXI B, 210); **33** (XLV, 735*); **70** (XIX, 557*); **104** (XII, 313). *Eidamia viridescens* Horne & Williamson in **33** (XXXVII, 430*, 1923); **33** (XLVI, 391); **66** (CCXX B, 99); **116**, 87. Common on wood, in soil, etc.; a stage of *Hypocrea rufa*. A fungus agreeing with *T. viride* was also cultured from *Hypocrea gelatinosa*.
[**Tubercularia Ligustri** Cooke in **14** (XVI, 49) is *Dendrophoma pleurospora* Sacc., teste Petch **28** (XXIV, 53).]
Tubercularia versicolor Sacc. Cooke **14** (XVII, 12, 1888); **8**, 463. On *Buxus*, Kew. Cooke's specimens apparently were not kept, but Petch **28** (XXIV, 53) reports that *T. versicolor* is not uncommon.
— **vulgaris** Tode ex Fr. Petch **28** (XXIV, 33, 1940) finds practically all British records of *Tubercularia* to be this species. The records were published under the following names: *T. Aesculi* Opiz, *T. Aquifolia* Cooke & Massee, *T. Berberidis* Thuem., *T. conorum* Cooke & Massee, *T. granulata* Pers., *T. nigricans* (Bull.) Gmel., *T. Sambuci* Corda, and *T. vulgaris* Tode; the following records are separated by Petch as 'Form *minor* Link': *T. Brassicae* Lib., *T. confluens* Pers., *T. Euonymi* Roum., *T. expallens* Fr., *T. herbarum* Fr. *T. minor* Link and its var. *Syringae* Cooke & Massee, *T. sarmentorum* Fr., and *T. subpedicellata* Schw.—Dillenius, *Hist. Muscorum*, t. 18, 1741 apparently figured *T. vulgaris* as *Tremella purpurea*, and most subsequent British mycologists have included it as *Tubercularia* or as *Nectria cinnabarina*.
Verticillium agaricinum Corda. **15**, 777, 1871; **14** (XI, 45*); **8**, 328; **7**, 334; **28** (XXI, 273). On *Russula* and *Lactarius*, a stage of *Hypomyces ochraceus*. See *Blastotrichum*.
— '**albidum** Sacc.' Massee **37** (1909, 376). On gorse, Kew. No other reference to this name was found.
— **albo-atrum** Reinke & Berth. **25** (X, 256, 1910; XI, 447; XII, 355 and 466; XVI, 584; XVII, 604); **33** (XXVI, 129; XXXVII, 519); **70** (XV, 63*); **34** (IX, 116); **28**

(III, 223); **34** (VIII, 13; IX, 116); **82** (VI, 26; VII, 32; XIII, 38; XIV, 36); **23** (XXX, 450; XLIII, 121); **77** (for 1924, 1933, 1935, 1936); **24** (X, 291); **65** (XXX, 342); **79** (I, 29; IV, 28; V, 29; VIII, 24; XI, 48); **22** (Misc. Publ. 21, 52, 79); **112**, 330; **85** (1928, 1934 to date); **93**. On potato, tomato, etc. Massee **31** (3, XVII, 708, 1895) may have had *V. albo-atrum* on tomato. See *V. Dahliae*.

Verticillium allochroum (Link ex Fr.) Corda. **120**, 553, 1821 as *Botrytis*. On stems.

— **ampelinum** Cooke & Massee in **14** (XVI, 79, 1888); Sacc. X, 545; **8**, 327. On vine stems, Kew.

— **botryoides** Sacc. **28** (XVI, 15, 1931). On *Leocarpus fragilis*, Yorks.

— **Buxi** (Link ex Fr.) Auersw. & Fleisch. **14** (XVI, 63, 1887); **8**, 330; **35** (1914, 16); **70** (1936, 412). On box leaves. See *Gliocladium roseum*.

— **candelabrum** Bon. **14** (XVI, 62, 1887); **8**, 326; **7**, 334; **28** (IV, 205). On old wood, etc.

— **cinerescens** Wollenw. **34** (XXII, 630, 1935); **31** (3, XCVIII, 267; XCIX, 82); **104** (XIV, 216); **82** (XX, 46; XXI, 46); **84** (VI, 89); **93**, 187. In wilt of *Dianthus*. —The species was transferred to *Phialophora* by van Beyma in *Antonie van Leeuwenhoek* VI, 47, 1939.

— **compactiusculum** Sacc. **14** (XVI, 63, 1887); **8**, 327. On old plants.

— **crustosum** (Fr.) Rabenh. As *Botrytis*: **20**, 343, 1836; Berk. Exs. 333. On Umbelliferae.

— **Dahliae** Kleb. **77** (1928, 84); **112**, 331; **70** (V, 30; XI, 53); **22** Bulls. 70 and 79); **28** (XIV, 164); **65** (XXX, 340); **77** (1932, 48; 1933, 82); **93**; first reported but not identified **104** (IV, 221, 1925); **77** (1925, 126; 1927, 81). In wilt of various plants. Some of the records of *V. albo-atrum* may belong here; or *V. Dahliae* may be a synonym, since it is said to differ from *V albo-atrum* only in producing sclerotia.

— **distans** Berk. & Br. in **19** (2, VII, 102*, No. 534, 1851); Sacc. IV, 151; **15**, 599; **8**, 327. On stems. Spores said to become two-celled.

— **epimyces** Berk. & Br. in **19** (2, VII, 102*, No. 533, 1851); Sacc. IV, 154; **15**, 599; **8**, 329; **7**, 334; **28** (VII, 10). On *Elaphomyces*, etc

— **globuliforme** Bon. var. **ellipsoideum** Grove in **27** (LVI, 345*, 1918); **28** (VI, 373). On *Juncus*, Warwicks.

— **lactescentium** Sacc. in *Syll.* IV, 153, based on unnamed conidial state said by Plowright **14** (XI, 47*, 1882) to belong to *Hypomyces terrestris*; **14** (XVI, 63); **8**, 328. Petch **28** (XXI, 273) places *H. terrestris* as a synonym of *H. ochraceus*, with *V. agaricinum* as the name of the conidial stage.

— **Malthousei** Ware in **33** (XLVII, 781, 1933); **85** (1934 to 1938; fungus mentioned as N.sp. 1931–33). On cultivated mushrooms.

— **Marquandii** Massee in **28** (I, 24, 1898); Sacc. XVI, 1037; **35** (1910, 25; 1911, 171). On *Hygrophorus*.

— **nanum** Berk. & Br. in **19** (2, VII, 101*, No. 532, 1851); Sacc. IV, 152; **15**, 599; **48** (II, 259); **8**, 328. On pears.

— **nigrescens** Pethybr. in **28** (VI, 117*, 1919); Sacc. XXV, 706. On potato, Ireland.

— **nubilum** Pethybr. in **28** (VI, 117*, 1919); Sacc. XXV, 706. On potato, Ireland.

— **quaternellum** Grove in **27** (XXII, 197*, 1884); Sacc. IV, 154; **8**, 329; **37** (1909, 376, on blackberry). On *Mycena*.

— **Rexianum** Sacc. **14** (XXII, 44, 1893); **71** (XXVIII, 148). On *Physarum*.

— **tenuissimum** Corda. **28** (VI, 55, 1918). On timber.

— **terrestre** (Pers. ex Fr.) Sacc. **8**, 327. As *Stachylidium*: **120**, 553, 1821; **39**, t. 257; **20**, 341. As *Botrytis*: **19** (1, VI, 437*, No. 240, 1841); **15**, 592; **13**, 275. *S. candidum* Grev. in *Mem. Wern. Nat. Hist. Soc.* I, 72*, 1822; **51**, 466. On soil and old wood.

— **tubercularioides** Speg. Cited by Petch **28** (XXI, 261, 1938) as conidia of *Nectria ochroleuca*.

— **Vilmorinii** (Guég.) 'Westerdijk & van Luijk' (stated to be a *Verticillium* in *Meded. Phytopath. Lab. Willie Commelin Scholten* VIII, 50, 1924, but the combination was not actually made); **112**, 331; **79** (VI, 28; XI, 56); **22** (Misc. Publ. 52,

70, 79); *Cephalosporium Asteris* Dowson in **56** (XLVIII, 57*, 1923). In wilt of *Aster*.

[**Verticillium Vizei** B. & Br. in Vize Exs. 247 and **14** (XVI, 63) is a nomen nudum.]

Volutella Arundinis (Desm. ex Fr.) Sacc. **8**, 475. As *Psilonia*: **19** (I, 49, No. 35, 1837, and No. 551); **15**, 624; Berk. Exs. 102. On reeds, etc.

— **Boydiana** Sacc. in *Syll.* X, 718; *V. citrina* Cooke & Massee [non Ellis & Ev.] in **14** (XVIII, 74, 1890). On *Trollius*, Scotland.

— **Buxi** (DC ex Fr.) Berk. & Br. in **19** (2, V, 465, No. 495, 1850); Sacc. IV, 685; **8**, 475. As *Fusisporium*: **20**, 352, 1836; Berk. Exs. 55. As *Chaetostroma*: **19**, No. 898; **15**, 788; Cooke Exs. 553 and II, No. 160. On box leaves.

— **ciliata** Fr. **19** (2, V, 465, No. 495, 1850); **15**, 556; **13**, 266; **8**, 473*; **60** (1901, 28*); **33** (XVI, 88); **7**, 348; **71** (XLII B, 54). *Psilonia rosea* Berk. in **20**, 353, 1836; Berk. Exs. 56. On old plants. See *V. roseola*.

— **ciliata** var. **stipitata** (Lib.) Sacc. **8**, 473; **19** (4, VII, 431, No. 1312, 1871) as *Chaetostroma stipitatum* (Lib.) Corda; *Volutella stipitata* (Lib.) B. & Br. ex Cooke in **14** (I, 20, 1872). On old plants.

— **discoidea** (Berk. & Br.) Sacc. in *Syll.* IV, 687; **8**, 475. *Psilonia* B. & Br. in **19** (3, XVIII, 122*, No. 1150, 1866); **15**, 624. Var. *lateritia* B. & Br. was proposed in **19**, No. 1319. On wood.

— **Festucae** (Lib.) Sacc. **8**, 476, 1893; **40** (IX, 41, 1887) as var. *bacillaris* nomen nudum. On *Festuca*.

— **gilva** (Pers. ex Fr.) Sacc. **8**, 475; **28** (VI, 87). As *Psilonia*: **20**, 353, 1836; **15**, 623; Berk. Exs. 101. On old plants.

— **Hyacinthorum** (Berk.) Berk. & Br. in **19** (2, V, 465, No. 495, 1850); **15**, 557; Sacc. IV, 684; **14** (XVII, 13); **8**, 474; **71** (XXVIII, 150). *Psilonia* Berk. in **20**, 353, 1836. On old bulbs, etc.

— **longipila** A. L. Smith & Ramsb. in **28** (VI, 53, 1918); Sacc. XXV, 958. On *Ulex*, Scotland.

— **melaloma** Berk. & Br. in **19** (2, V, 465*, No. 496, 1850); Sacc. IV, 688; **15**, 557; **8**, 476. On *Carex*.

— **nivea** Sacc. **8**, 474, 1893; **37** (1911, 377). On bark and *Scleroderma*.

[— **Phaii** Pim. **71** (XXVIII, 150). The original description has not been seen.]

— **roseola** Cooke in **14** (I, 20, 1872); Sacc. IV, 684; **8**, 474; **71** (XXVIII, 150); *Proc. Birmingham Nat. Hist. Phil. Soc.* XVI, 93, with *Cephalosporium Acremonium* stage. In soil, etc.; perhaps only a form of *V. ciliata*.

— **setosa** (Grev. ex Fr.) Berk. & Br. in **19** (2, V, 465, No. 495, 1850); **15**, 557*; **13**, 266; **8**, 474; **7**, 348; **71** (XXVIII, 150; Cooke Exs. II, No. 159. *Aegerita* Grev. in **39**, t. 268, 1823; *Psilonia* Berk. in **20**, 353, 1836. On stems, etc.

GLOIOSPORAE—ENDOSPORAE

The spores are interpreted as 'slime-spores', although they often persist in chains.

Chalara fungorum Sacc. **27** (LXXIII, 188, 1935); **1** (II, 116*). On *Sphaeronemella* on *Sparassis*, Norfolk.

— **fusidioides** Corda. **35** (1936, 59); **28** (XXIV, 56). On *Nectria coccinea*, Yorks. Pim **71** (2, IV, 27) reported *C. Cocos* (nomen nudum) 'doubtfully distinct from *C. fusidioides*'.

— **longipes** (Preuss) Berk. & Br. in **19** (5, VII, 130, No. 1911, Feb. 1881); **14** (X, 50); Sacc. IV, 335; **8**, 389*; **35** (1909, 419). As *Cylindrosporium*: **19**, No. 1705, 1878; **14** (VI, 126). Two British collections reported; the first, on walnut shell, Scotland, was apparently *Chalaropsis thielavioides*, see **104** (XIII, 104). The Yorkshire collection was on decaying bark.

— **longissima** Grove in **27** (XXIII, 167*, 1885); Sacc. IV, 334; **14** (XIV, 133); **8**, 388. On wood, Warwicks.

[— **minuta** Trail, nomen nudum in **40** (IX, 41).]

Chalaropsis thielavioides Peyron. **77** (1931, 146; 1932, 74); **22** Bull. 79; **104** (XIII, 81*); **28** (XIX, 158); **93**, 98. On *Juglans*, etc.

Sporendonema casei Desm. ex Fr. **20**, 351, 1836; **40** (IV, 347). *Torula Sporendonema* B. & Br. in **19** (2, V, 460, No. 462, 1850); **15**, 478; **13**, 229; **71** (2, IV, 27). As *Oospora crustacea* (Bull.) Sacc.: **8**, 280; **48** (V, 9); **7**, 327. On cheese, etc. Early records of *Mucor caseus*, e.g. **38** (Ed. 3, IV, 402, 1796); **55** (II, 722), may have referred to this fungus.—See Beauverie, *Études Polymorphisme Champ.*, 1900. Most records as *Sporendonema casei* belong to the dry-spored genus *Scopulariopsis*.

Sporoschisma mirabile Berk. & Br. gen.nov. in **19** (2, V, 461, No. 467, 1850); Sacc. IV, 486; **15**, 482*; **14** (XVI, 110); **13**, 321; **73** (1877, 5); **40** (V, 277; VII, 327); **8**, 422*; **46** (II, 346); **28** (I, 164). Nomen nudum in **31** (1847, 540). On old wood.

Thielaviopsis basicola (Berk. & Br.) Ferraris in *Fl. Ital. Crypt.* I, VI, 233, 1912; **67** (CXIB, 210); **79** (XI, 49; XII, 28); **23** (XLIII, 124); **93**; **22** (Bulls. 79 and 117). *Torula* B. & Br. in **19** (2, V, 461*, No. 465, 1850); **15**, 477; **14** (XVI, 97); Sacc. IV, 257; **8**, 360. As *Thielavia* in error: **23** (XV, 203 and 439; XXI, 421); **35** (1909, 238*); **37** (1912, 44); **33** (XXIX, 483*); **25** (XVII, 464; XXI, 203; XXII, 110); **82** (XI, 74; XII, 26); **79** (IV, 28; V, 25); **65** (XXX, 341). *Milowia nivea* Massee gen.nov. in **68** (2, IV, 841*, 1884); **14** (XIV, 6; XVI, 96); **8**, 348*; **7**, 336; **28** (IV, 169). On various plants.

GLOIOSPORAE—DIDYMOSPORAE

Cylindrocladium scoparium Morgan. **80**, 66, 1923; *Rose Annual* 1933, 110; **77** (1933, 83; 1937, 189). On *Rosa* and *Prunus*.

GLOIOSPORAE—PHRAGMOSPORAE

Atractium flavoviride Sacc. **28** (XXI, 263, 1938). As *Fusarium melanochlorum* Casp.: Wollenweber, *Fus. autogr. del.* t. 1103 and 1123. On wood, stage of *Sphaerostilbe flavoviridis* Fuckel.

Candelospora ilicicola Hawley in **71** (XXXI, Part 13, 11*, 1912: *Candelospora* Rea & Hawley gen.nov. ibid., p. 11); **28** (IV, 182). On dead leaves of *Ilex Aquifolium*, Clare Island. See **100** (XXIX, 211).

Cylindrocarpon album (Sacc.) Wollenw. **79** (VI, 18). As *Fusarium*: **37** 1909, 376); **70** (XXI, 417). **28** (X, 117, 1924) as *Ramularia heteronema* (B. & Br.) Wollenw.; see *Zeit. Parasitenkunde* I, 153. On *Ulmus*, *Pyrus*, *Narcissus*, etc.

— **Ehrenbergii** Wollenw. As *Fusarium Brassicae* Thüm.: **14** (XVII, 14, 1888); **8**, 480; **7**, 349; see Wollenw. & Reinking, *Die Fusarien*, 319. On old *Brassica*.

— **heteronemum** (Berk. & Br.) Wollenw. in *Zeit. Parasitenkunde*, I, 149, 1928. *Fusarium* B. & Br. in **19** (3, XV, 402*, No. 1051, 1865); **15**, 559*; **14** (XVII, 15); **8**, 483. On pears.

— **Mali** (Allesch.) Wollenw. **28** (X, 116, 1924); **78** (1938, 87); **34** (VII, 189, 1920) as *Fusarium*. On apples.

— **obtusisporum** (Cooke & Harkn.) Wollenw. *Fusisporium obtusum* Cooke in **14** (V, 58, 1876). *Fusarium obtusum* (Cooke) Sacc. in *Syll.* IV, 708; **14** (XVII, 15); **8**, 482. On *Diatrype*, Scotland.

— **radicicola** Wollenw. **104** (XI, 261, 1933; XII, 222); **79** (XI, 37 and 57); **78** (1934, 306); **84** (III, 187); **22** (Bull. 79, p. 109; Bull. 117, 85). On lettuce, strawberry, narcissus, and lily.

— **Willkommii** (Lindau) Wollenw. As *Fusarium*: **79** (VII, 18, 1930); **28** (XXI, 265). Conidial stage of *Nectria galligena*.

Fusarium anguioides Sherb. **34** (XVII, 289, 1930). In a salt marsh, Wales.—The British records of *Fusarium* are compiled under the names given in *Die Fusarien*, 1935.

— **aquaeductum** (Radlk. & Rabenh. p.p.) Lagerh. **28** (XVII, 112, 1932). In sewage.—Said to be a stage of *Nectria episphaeria* var. *coronata*.

Fusarium argillaceum (Fr.) Sacc. W. G. Smith **81**, 30*, 1884 as *Fusisporium Solani* Mart., teste Wollenw. in *Zeit. Parasitenkunde*, III, 427; see also **31** (XVII, 483; 2, XXIII, 14; 2, V, 656) and **15**, 622. On potatoes.

— **arthrosporioides** Sherb. **70** (XV, 218, 1917); **34** (XVII, 44). From potatoes and wheat.

— **avenaceum** (Fr.) Sacc. **22** (Bull. 21, 1917); **28** (X, 115; XXII, 113); Bennett **34** (XV, 213); **34** (XVI, 261; XX, 272; XXV, 96); **85** (XXXVII, 15); **35** (1936, 60); **87** (XII, 164); **22**, Bull. 117. *F. diffusum* Carm. ex Cooke in **14** (XVI, 81); **8**, 480. As *F. herbarum* (Corda) Fr.: **34** (XVI, 261; XXII, 479* and 630); **104** (VII, 302); **82** (XIV, 62; XXI, 44); **87** (XII, 164); **88** (XI, XII); **85** (1924); **22** (Bull. 79) as *F. herbarum* var. *avenaceum*; **34** (XXII, 484) as *F. herbarum* f. 2; **31** (3, LVIII, 289) as *F. putrefaciens* Osterw. As *F. tubercularioides* (Corda) Sacc.: **14** (XVII, 14); **8**, 479; **23** (XIV, 685); **22** (Bull. 79, p. 105); **79** (XI, 59); **84** (III, 189). As *F. viticola* Thüm.; **14** (XVI, 11); **8**, 479; **28** (X, 114). *Fusisporium incarcerans* Berk. in *Intell. Obs.* 1863, 11*; **15**, 622. *Fusarium incarcerans* (Berk.) Sacc. in *Syll.* IV, 713; **8**, 483. As *Selenosporium tubercularioides* Corda: **19** (5, VII, 130, No. 1904, 1881); **14** (X, 49). On cereals, tulips, etc.

— **avenaceum** form **1** Wollenw. **28** (X, 114, 1924) as *F. arcuatum* Berk. & Curt. and *F. anthophilum* Wollenw. As *F. anthophilum*: **104** (VII, 302); **82** (XIV, 64). In apples and carnations.

— **bulbigenum** Cooke & Massee in **14** (XVI, 49, 1887); Sacc. X, 725; **8**, 482; **83** (LXXV, 593); **37** (1913, 307); **23** (XX, 1091); **5A**, p. 9 of Appendix; **34** (IV, 36); **56** (XLIII, 51); **34** (XIX, 475; XXII, 684); **79** (II, 21 and 32; VI, 18; XI, 57); **112**, 345; **33** (L, 333); **22**, Bull. 117. Perhaps **19** (5, VII, 130*, No. 1907, 1881) as '*F. Equiseti* Desm.'; **14** (X, 49). As *F. Equisetorum* (Lib.) Desm.: **14** (XVII, 15); **8**, 485. On *Narcissus*, etc.—Snyder & Hansen rename this *F. oxysporum* f. *Narcissi* in *Amer. J. Bot.* 1940.

— **bulbigenum** var. **Lycopersici** (Brushi) Wollenw. As *F. Lycopersici*: **56** (XIX, 20*, 1895); **31** (3, XVII, 707*); **23** (V, 192; XI, 301; XIII, 101; XVII, 301); **5B**, 328; **5**, 490; **56** (XXVII, 819); **80**, 84; **112**, 347; **23** (XXXIII, 48; XXXVIII, 60); **22**, Bull. 79, as *F. bulbigenum*. In *Lycopersicum esculentum* in hot weather. *Verticillium* is the commoner cause of 'Sleepy Disease'.

— **bulbigenum** var. **niveum** (E. F. Smith) Wollenw. **80**, 87, 1923 as *F. vasinfectum* var. *niveum*; **23** (LII, 82). On melons.

— **caeruleum** (Lib.) Sacc. **14** (XVII, 14, 1888); **8**, 481; **23** (XXI, 13; XXIII, 45; XXXIII, 38; XXXVIII, 29; LII, 25; LXX, 20); **25** (XVI, 595; XVII, 601); **70** (XV, 193); **28** (VII, 195); **33** (XXXVIII, 137); XLVI, 1034); **79** (III, 23; V, 24; XI, 46); **112** 348; **96** (I, 42); **65** (XXX, 343); **71** (XL, 55); **85** (XXXV, 18; XXXVII, 15; XLI, 16). In Dry Rot of potato tubers.

— **Carpini** Schulz. & Sacc. **62** (XII, 83, 1924). On *Carpinus*. A doubtful record.

— **ciliatum** Link sensu Wollenw. *Fusisporium filisporum* Cooke in **14** (VIII, 8, 1879).—*Fusarium filisporum* (Cooke) Sacc. in *Syll.* IV, 708; **8**, 482. On *Orthotrichum*, Eastbourne.

— **conglutinans** Wollenw. var. **Callistephi** Beach. **31** (XCV, 215, 1934); probably this fungus as F.sp. **56** (XXXV, p. CXXV); **82** (X, 66); **22** (Bull. 79). In *Callistephus*.

— **culmorum** (W. G. Smith) Sacc. in *Syll.* XI, 651; **23** (XXIII, 43, 1920; XXXVIII, 14; LII, 13); **89**, 232*; **22** (Bull. 79); **34** (XV, 213; XVI, 261; XIX, 482; XX, 272; XXII, 630); **28** (X, 116; XVI, 253; XVIII, 249; XIX, 147; XXI, 114); **112**, 349; **85** (XXXVII, 15); **87** (XII, 164); **104** (VII, 302; XI, 261; XIV, 218); **82** (XIV, 43 and 64; XX, 46; XXI, 44); **31** (XCVIII, 267); **99** (XXVII, 86); **84** (VI, 87 and 93); **71** (XLB, 55); **33** (XLI, 520; XLIII, 379; L, 333). *Fusisporium* W. G. Smith in **81**, 208*, 1884; **102** (X, 471; XII, 48) as *Fusarium rubiginosum* Appel & Wollenw. On cereals, etc.

— **culmorum** var. **cereale** (Cooke) Wollenw. *Fusisporium cereale* Cooke in **14** (VI, 139, 1878, from Florida); **27** (XXII, 200*, 1884); **60** (XX, 92). On wheat, Warwicks.

Fusarium Dianthi Prill. & Delacr. **34** (XXII, 630, 1935); **82** (XXI, 45); **104** (XIV, 219); **84** (VI, 93). In *Dianthus*.

— **Equiseti** (Corda) Sacc. **34** (XXII, 487, 1935); **23** (XLIII, 124); **34** (XXII, 490*) as forma 1. *F. Cordae* Massee in **8**, 481, 1893; **7**, 349. On cereals, etc.

— **flocciferum** Corda. **99** (XXVI, 86); *F. vinosum* Massee in **8**, 479, 1893. On mushrooms, etc.

— **graminearum** Schwabe. **68** (1883, 321*); **81**, 209*; **22** (Bull. 79); **23** (XXXVI, 6); **34** (XVII, 43; XVIII, 158; XX, 272 and 377). *Fusisporium insidiosum* Berk. in **31** (1860, 480); **18**, 355; **15**, 622. *Fusarium insidiosum* (Berk.) Sacc. in *Syll.* IV, 707; **14** (XVII, 14); **8**, 483; **89**, 241*. On cereals and grasses, a stage of *Gibberella Saubinetii* (*G. Zeae*).

— **heterosporum** Nees ex Fr. **31** (1860, 958); **19** (3, VII, 449, No. 955, 1861); **15**, 559; **14** (XVII, 14); **8**, 481; **5B**, 331; **5**, 493; **89**, 237*; **7**, 349; Vize Exs. 351. *Fusisporium Lolii* W. G. Smith in **81**, 213*, 1884; *Fusarium Lolii* (W. G. Smith) Sacc. in *Syll.* XI, 652. On grasses and *Claviceps*.

[— **inaequale** Auersw. **14** (XVII, 14); **8**, 480. Identity unknown.]

[— **Kuehnii** (Fuckel) Sacc. **8**, 484; **14** (IV, 120, 1876) as *Fusisporium*. On mosses and lichens, Norfolk. A state of *Corticium centrifugum*. See *Oester. Bot. Zeit.* LIV, 427.]

— **lateritium** Nees ex Fr. **19** (1, IV, 438, No. 249, 1841); **18**, 341; **15**, 558; **13**, 266; **8**, 478; **14** (XVII, 14); **7**, 349; Berk. Exs. 262. As var. *fructigenum*: **85** (XXIX, 16; XXXV, 21); **22** (Bull. 79); **71** (XLII, 54); **79** (XI, 50); **34** (XXV, 96). As *F. fructigenum* Fr.: **28** (X, 98; XII, 170; XV, 96; XIX, 147); **34** (XII, 17); **22** (Bull. 70); **67** (CIIB, 427 and 444; CVB, 375); **33** (XLVI, 1034; XLVII, 548; XLVIII, 188 and 363; L, 333 and 700); **79** (X, 32; XII, 25); **112**, 351. *F. Blackmani* Brown & Horne in **33** (XXXVIII, 383; XXIX, 373; XL, 203 and 229; XLII, 285; XLIII, 245). As *F. pyrochroum* Sacc.: **14** (XVII, 14); **8**, 279. On apples, etc., stage of *Gibberella baccata* (Wallr.) Sacc.

— **lateritium** var. **Mori** Desm. **23** (LXX, 56). As *F. lateritium*: **31** (3, LX, 95, 1916); **77** (1928, 83). On *Morus*.

— **Lini** Bolley. **28** (II, 15, 1903); **89**, 251*; **23** (XIX, 33); **25** (XX, 339; XXI, 180; XXII, 109); **112**, 351. On *Linum*.

— **merismoides** Corda. **34** (XXII, 504*) as var. *majus*. As *Fusisporium Betae* Desm.: **19** (1, VI, 438, No. 246, 1841); **15**, 620; **13**, 287. As *Pionnotes Betae*: **37** (1906, 49*); **71** (XXVII, 150). As *Fusarium Betae*: **8**, 484. As *Pionnotes Biasolettiana* Corda: **14** (XVII, 80); **8**, 486. *Fusisporium foeni* B. & Br. in **19** (2, VII, 179, No. 550, 1851); **15**, 621. As *Fusarium foeni*: **14** (XVII, 14); **8**, 480. As *Fusisporium Georginae* Klotz.: **19**, No. 247, 1841; **15**, 620. *Fusisporium roseolum* Stephens ex B. & Br. in **19** (2, VII, 178, No. 549); **15**, 621; **31** (2, XXII, 40*); Vize Exs. 253. As *Fusarium roseolum*: **14** (XVII, 15); **8**, 483. *Fusisporium udum* Berk. in **19** (1, VI, 438*, No. 245, 1841); **15**, 620. As *Pionnotes uda*: **14** (XVII, 15); **8**, 486. As *Fusarium udum*: **28** (XVII, 14); **71** (XLII, 54). On decaying plants.

— **moniliforme** Sheldon. **79** (VI, 18, 1930). On *Narcissus*.

— **moniliforme** var. **subglutinans** Wollenw. & Reinking. **34** (XIX, 485, 1932). On *Narcissus*.

— **nivale** (Fr.) Ces. **86** (II, 116, 1931; III, 79); **22** Bull. 79; **79** (IX, 22 and 42; XI, 59); **34** (XX, 272); **85** (XXXV, 20); **87** (XII, 164). As *F. minimum* Fuckel: **14** (XVII, 14, 1888); **8**, 481. On grasses; stage of *Calonectria graminicola*.

— **orthoceras** Appel & Wollenw. **104** (XII, 235, 1934); **34** (XVII, 288) as *F. oxysporum* var. *resupinatum* Sherb. In strawberry roots and soil.

— **oxysporum** Schlecht. ex Fr. **34** (IX, 117, 1922); **28** (XVII, 229; **22** (Bull. 79); **99** (XXVII, 86). *F. Myosotidis* Cooke in **14** (XVI, 49, 1887); **8**, 480; Vize Exs. 576. Causing wilt of potatoes, and in cultivated mushrooms.

— **oxysporum** var. **aurantiacum** (Link) Wollenw. As *Fusisporium aurantiacum* Link: **20**, 351, 1836; **15**, 622; **13**, 287. As *Fusarium aurantiacum*: **14** (XVII, 15); **8**, 485. As *Fusoma parasiticum* Tub.: **85** (XI, 87*); **23** (XXIX, 355); Hiley, *Diseases of Larch*. As *Fusarium sclerotioides* Sherb.: **34** (IX, 117); **78** (1929, 150). On herbs, etc.

Fusarium oxysporum var. **Gladioli** Massey. **22,** Bull. 117, 1939. On *Gladiolus*.
— **Pelargonii** Cooke [non Crouan?] in **31** (3, xx, 92, 1896); **56** (xxvii, 39); **89,** 40. On *Pelargonium*. Not cited in *Die Fusarien*.
— **redolens** Wollenw. **99** (xxvii, 94, 1937). On cultivated mushrooms.
— **reticulatum** Mont. **31** (3, xx, 248, 1896); **56** (xxvii, 822); **89,** 100. In melons and cucumbers.
[— **rhabdophorum** B. & Br. in **19** (4, xvii, 142, No. 1612, 1876); **8,** 484. This is said to be a *Cylindrosporium*.]
— **roseum** Link ex Fr. **20,** 355, 1836; **15,** 559; **28** (I, 184); **68** (1901, 615); **8,** 480; Cooke Exs. 344 and II, No. 339, and other early records, all doubtful.
[— **salicinum** Corda. **19,** No. 1908, 1881; **8,** 484. This is *Libertella salicina* (Corda) Wollenw.]
— **sambucinum** Fuckel. **34** (xxi, 493*); **99** (xxvii, 94). *Fusisporium Hordei* W. G. Smith in **81,** 212*, 1884; **89,** 234* as *Fusarium Hordei*. On various hosts; stage of *Gibberella pulicaris*.
— **sambucinum** f. **1** Wollenw. **34** (xxii, 497*, 1935). From grasses.
— **sambucinum** f. **6** Wollenw. **99** (xxvii, 94, 1937). On cultivated mushrooms.
— **sarcochroum** (Desm.) Sacc. **14** (xvii, 14, 1888); **8,** 478. On bark.
— **Scirpi** Lamb. & Fautr. Bennett **34** (xix, 21*, 1932) described var. *pallens* and var. *nigrans* from *Triticum* and *Hordeum*. Both are placed as *F. Scirpi* in *Die Fusarien*.
— **Scirpi** var. **acuminatum** (Ellis & Everh.) Wollenw. **82** (xxi, 44). As *F. acuminatum* Ell. & Ev.: **104** (vii, 302); **82** (xiv, 64); **33** (xxxix, 373); **34** (ix, 117, 1922) as *F. ferruginosum* Sherb. In *Dianthus*, etc.
— **Scirpi** var. **filiferum** (Preuss) Wollenw. *Fusisporium mucophytum* W. G. Smith in **31** (2, xxii, 245*, 1884). *Fusarium mucophytum* (W. G. Smith) Cooke in **14** (xvii, 15); **8,** 483; **7,** 349. On agarics.
— **Solani** (Martius) Sacc. **79** (vi, 18); many more or less meaningless older records, e.g. **56** (xxvii, p. liv); **89,** 91; **36** (xxxix, 120); **23** (xvi, 858); **102** (x, 471; xii, 47); **8,** 481; **56** (xxix, 141); **31** (3, xxxv, 257); erroneously considered by Massee **5,** 180* and 565 to be the conidial stage of *Nectria Solani*. As *F. commutatum* Sacc.: **68** (1901, 615*); **28** (I, 185). As *F. viride* (Lechm.) Wollenw.: **61** (cxxxviii, 67); **18,** 356 as *Fusisporium Solani-tuberosi* Desm. On potatoes, etc.—Saccardo was the first to transfer Martius's name to *Fusarium*; it is immaterial that he was studying another fungus.
— **Solani** var. **Martii** (Appel & Wollenw.) Wollenw. **31** (3, xcvii, 243); **79** (xi, 46). *F. epimyces* Cooke ex Massee in **8,** 482; nom. nud. **14** (xvii, 15). As *F. Martii* Appel & Wollenw.: **28** (x, 116); **79** (x, 38; xi, 49); **99** (xxvii, 86). On mushrooms, etc.
— **Solani** var. **Martii** f. **1** Wollenw. **28** (x, 116, 1924) as *F. Martii* var. *viride* Sherb. In apples.
— **Solani** var. **Martii** f. **2** Snyder. **78** (1934, 187). As *F. Martii* var. *Pisi* F. R. Jones: **78** (1930, 135; 1931, 129; 1932, 110). On *Pisum*.
— **Solani** var. **Martii** f. **3** Snyder. As *F. Martii* var. *Phaseoli* Burkh.: **78** (1929, 151; 1930, 128; 1931, 124; 1933, 102); **79** (x, 39); **22** (Bull. 79) as *F. Solani* var. *Martii*. On *Phaseolus*.
— **Sphaeriae** Fuckel. **27** (lxx, 37*, 1932). On *Leptosphaeria doliolum* on *Urtica*, etc.; stage of *Lasionectria Leptosphaeriae*.
— **sporotrichioides** Sherb. **104** (vii, 305, 1929); **82** (xiv, 64). On *Dianthus*.
— **translucens** Berk. & Br. in **19** (4, xvii, 141, No. 1610, 1876); Sacc. iv, 721; **14** (v, 58); **40** (iii, 272); **13,** 267; **8,** 485. On 'deal', Scotland. Doubtful; considered possibly a *Hymenula* in *Die Fusarien*.
— **trichothecioides** Wollenw. **34** (xxii, 500*, 1935). On *Triticum* and *Hordeum*.
— **tricinctum** (Corda) Sacc. **34** (xxii, 502*, 1935). Saprophytic on several plants.
— **vasinfectum** Atk. Reported **23** (xxiii, 48) and **63** (lxxxvii, 313). On beans and peas.
[— spp. There are numerous British records of '*Fusarium* sp.' on various hosts. Cards giving these records, and more detailed reports of the hosts of the species

mentioned above, are in the custody of Mr W. C. Moore of the Ministry of Agriculture Laboratory, Harpenden, who has assisted us greatly in compiling records of *Fusarium*.]

Mastigosporium album Riess. **40** (IX, 41, 1887); **26A** (Bull. H I, 1922); **87** (I, 106); **22** (Bull. 79); **28** (XXII, 168*). On *Alopecurus*.

— **rubricosum** (Dearn. & Barth.) R. Sprague in **100** (XXX, 43); syn. *M. calvum* (Ellis & Davis) R. Sprague in **110** (LVII, 298). As *M. album* var. *muticum* Sacc.: **37** (1918, 233); **28** (VI, 373; XXII, 168*); **26A** (Bull. H I); **85** (XXVI, 165). On *Dactylis*.

Microcera coccophila Desm. **15**, 556*, 1871; Cooke, *Vegetable Wasps* p. 322*; **14** (XVII, 15); **8**, 486; **28** (VII, 115*; XVII, 177; XXI, 262); **35** (1932, 134); Cooke Exs. 350 and II, No. 534; **19**, No. 1311, 1871 as *M.* '*coccophora* Desm.' *Atractium flammeum* Berk. & Rav. apud B. & Br. in **19** (2, XXI, 461, No. 757, 1854); Sacc. IV, 599; **18**, 340; **15**, 555*; **8**, 452*. On *Chionaspis*; stage of *Sphaerostilbe flammea* Tul.

INCERTAE—AMEROSPORAE

(Incertae Gloiosporae v. Xerosporae)

Calcarisporium arbuscula Preuss. **28** (III, 121*, 1909; XVI, 232). On fungi, Hants.

Cylindrocephalum stellatum (Harz) Sacc. var. **claviforme** Grove in **27** (LXX, 36, 1932). On horse dung, Liverpool.

Lasioderma flavovirens Dur. & Mont. **48** (XVII, 27, 1908). On leaves, Ireland.

XEROSPORAE—AMEROSPORAE

Acremoniella atra (Corda?) Sacc. **35** (1909, 419; 1911, 166); E. W. Mason, *Annotated Acc.* List II, Fasc. 2, 29*. *A. pallida* Cooke & Massee in **14** (XVI, 79, 1888); **8**, 379*; **27** (XXXV, 8); **27** (XXII, 197*) as *Botrytis coccotricha* Sacc.; **8**, 314. As *Eidamia acremonioides* (Harz) Lindau: **33** (XXXVII, 394; XXXVIII, 354). *Langloisula macrospora* A. L. Smith in **68** (1901, 617*); **28** (I, 185*; VI, 117*). On seeds, etc.

— **fusca** (Kunze & Schm. ex Fr.) Sacc. **14** (XVI, 99); **8**, 379; **71** (XXVIII, 149). As *Acremonium*: **39** (I, 121, 1823); **51**, 468; **20**, 347; **15**, 615; **13**, 286. On wood.

— **verrucosa** Togn. E. W. Mason, op. cit. p. 34, 1933; *Eidamia tuberculata* Horne & Jones in **33** (XXXVIII, 354, 1924). In wood, etc.

Acremonium album Preuss. **35** (1932, 126; 1936, 237); **28** (XVI, 242; XVII, 3). On Myxomycetes.

— **alternatum** Link ex Fr. **120**, 550, 1821; **20**, 347; **15**, 615*; **8**, 305*; **28** (I, 184); **68** (1901, 615); **7**, 331. On seedlings and leaves.

— **fimicola** Massee & Salm. in **33** (XVI, 79*, 1902); Sacc. XVIII, 523. On dung.

— **spicatum** Bon. **35** (1910, 405; 1911, 166); **28** (III, 286). In polluted water, Yorks.

— **tenuipes** Petch in **28** (XXI, 66, 1937). On spiders, Norfolk.

— **verticillatum** Link ex Fr. **120**, 550, 1821; **39**, t. 124; **20**, 347; **15**, 615*; **13**, 285; **14** (XVI, 60); **8**, 305; **7**, 331; **71** (XXVIII, 148). On wood.

Acrotheca acuta Grove in **27** (LIV, 222*, 1916); Sacc. XXV, 766. On old *Urtica*, Hereford.

— **canescens** Grove in **27** (XLV, 69*, 1907); Sacc. XXV, 767; **27** (L, 18). On roots; conidial stage of *Dasycypha canescens*.

· **Solani** Sacc. **8**, 372, 1893. On old potato leaves.

Aegerita candida Pers. ex Fr. **39**, t. 268, 1823; **20**, 324; **19** (3, III, 362*, No. 823, 1859); **15**, 561*; **19**, No. 1714; **13**, 268; **8**, 469*; **7**, 348; **71** (XXVIII, 150). On wood; stage of *Peniophora candida* Lyman.

Aegerita insectorum Petch in **28** (XXI, 63, 1937). On larva, Cambs.
— **virens** Carm. ex Cooke in **14** (XVI, 81, 1888); Sacc. X, 711; **8**, 469. On birch bark, Scotland.
— **viridis** Bayliss Elliott in **28** (VI, 56*, 1918); Sacc. XXV, 952. On wood, Warwicks. [= *Trichoderma viride*?]
Akanthomyces aculeata Lib. **35** (1932, 48 and 133); **28** (XVII, 176; XVIII, 72). On moths. See *Isaria Sphingum*.
Arthrinium caricicola Kunze ex Fr. **8**, 373*, 1893. On old *Carex*.
— **sporophlaeum** Kunze ex Fr. **18**, 346, 1860; **15**, 585*; **8**, 373; Berk. Exs. 311. On *Carex*.
Aspergillus candidus Link ex Fr. **20**, 339, 1836; **15**, 588; **8**, 296; **102** (X, 462); **33** (XVI, 83); **7**, 330. A common saprophyte.—See **66** (CCXXB), **116**, and G. Smith, *Industrial Mycology*, for references to *Aspergillus*. *The Aspergilli* by Thom & Church has been followed for names.
— **Chevalieri** (Mangin) Thom & Church. **33** (L, 702). British?
— **clavatus** Desm. **33** (XVI, 82*, 1902); **27** (LX, 174); **116**, 97. On paper, etc.
— **conicus** Blochwitz apud E. Dale in **102** (XII, 38*, 1914); **102** (XXVII, 206). In soil.
— **depauperatus** Petch in **28** (XVI, 244*, 1931); **28** (XVII, 174). On insects, Norfolk and Ceylon.
— '**dubius** Corda'. **19** (2, VII, 100, No. 520, 1851); **15**, 588. On dung of rabbit and mouse. '*Sterigmatocystis dubia* (B. & Br.) Sacc'. in *Syll.* IV, 72; **8**, 298; **33** (XVI, 81). Thom and Church did not know the species.
— **flavus** Link ex Fr. **120**, 555, 1821; **14** (XVI, 59); **8**, 297; **7**, 330; **116**, 83; **66** (CCXXB, 127); **37** (1907, 242) as '*A. flavus* de Bary'. On organic substances.
— **fumigatus** Fres. **35** (1915, 48); **27** (LV, 136); **75** (XXI, 123); **34** (XVII, 291); **70** (XIX, 552); **116**, 83. In soil, etc.
— **fumigatoides** Bain. & Sart. **34** (XVII, 296, 1930). In salt-marsh soil.
— **glaucus** Link ex Fr. **51**, 467, 1824; **58**, 211; **20**, 340; **65** (V, 193); **15**, 588*; **13**, 274; **8**, 295*; **7**, 330*; **68** (1901, 615); **28** (I, 184); **103** (V, 222); **28** (XVII, 221); **70** (XIX, 554*); Berk. Exs. 208. As *Mucor*: **38** (Ed. I, II, 784, 1776); **42**, t. 378; **55**, 721. **92**, 33 as *Monilia*; **102** (V, 419*; VII, 215) as *A. herbariorum* Wigg. A common saprophyte.
— **griseus** Link ex Fr. **19** (5, VII, 130, No. 1912, 1881); **40** (X, 50); **8**, 296; **35** (1915, 48). An uncertain species, recorded also as 'forma *fenestrale*' **14** (XVI, 59); as *Sporotrichum fenestrale* Ditm. **18**, 352; **15**, 611; and as *Byssocladium fenestrale* Link, **120**, 551, 1821.
— **luteoniger** (Lutz) Thom & Church. **70** (XIX, 315*, 1929). In milk, Ireland.
— **mollis** Berk. in **20**, 340, 1836; Sacc. IV, 67; **15**, 589; **8**, 296. On leaves, Norths. Still a doubtful species.
— **nidulans** (Eidam) Wint. **74** (VII, 145*, 1912); **28** (IV, 181); **75** (XXII, 123); **116**, 98; **66** (CCXXB). In beehives, etc.
— **niger** van Tiegh. **28** (II, 33, 1903; VIII, 115); **57** (V, 36); **23** (XIX, 85); **33** (XXXII, 531; XXXVII, 343); **22** (Bull. 38, p. 56); **75** (XXII, 123); **24** (XVI, 404); **32** (XXXIV, 211; XXXVI, 327); **90** (XIV, XV); **116**, 84 and 98; **73** (2, VII, 373) as *Sterigmatocystis*; *Rhopalocystis* Grove gen.nov. in **74** (VI, 40*, 1911); *A.* '*nigricans* Cooke' ex Sacc. in *Syll.* IV, 70; Cooke **14** (VI, 127, 1878) as *A.* '*nigricans* Auct.'; **7**, 330; **28** (VI, 59*) as *Sterigmatocystis phaeocephala* Sacc.; *Rhopalocystis phaeocephala* (Sacc.) Grove in **74** (VI, 40); **10**, 85 as *Ustilago ficuum* Reichardt. A common saprophyte.
— **ochraceus** Wilhelm. **75** (XXII, 123, 1924); **115**, 95. In air, etc.
— **Oryzae** (Ahlb.) Cohn. Listed **115**, 95, 1937.
— **repens** (Corda) Sacc. **102** (VII, 215*, 1909; X, 262); **33** (XXXVI, 262; L, 702); **66** (CCXXB, 27). In soil, etc.
— **roseus** Link ex Fr. **20**, 340, 1836; **15**, 588; **8**, 297. On paper, etc. Probably not an *Aspergillus*.
— **Schiemanni** Thom. Listed **115**, 95, 1937. It is a variant of *A. niger*.

Aspergillus spiralis Grove in **27** (XXIII, 164*, 1885); Sacc. IV, 69; **8**, 297. On a cork. Possibly *A. glaucus*.
— **sulphureus** (Fres.) Thom & Church. **27** (LIV, 220, 1916) as *Sterigmatocystis*; **28** (V, 430). On fabric.
— **Sydowi** (Bain. & Sart.) Thom & Church. **70** (XIX, 553, 1930); **66** (CCXXB). In butter, etc.
— **Tamarii** Kita. **66** (CCXXB), from Cambridge.
— **terreus** Thom. **70** (XIX, 20, 1929 and p. 554*); **66** (CCXXB). In butter, etc.
— **versicolor** (Vuill.) Tirab. **66** (CCXXB); **102** (XXII, 37) as *A. globosus* Jensen. In soil, etc.
— **virens** Link ex Fr. **51**, 467, 1824; **20**, 340; **15**, 589; **13**, 274; **8**, 296; **7**, 330. On fungi, etc. An unknown species.
Beauveria Bassiana (Bals.) Vuill. **28** (XVI, 59; XVII, 174; XX, 4); **35** (1932, 167); **116**, 144 as *Botrytis*; *Annotated Acc. Fungi Recd. I.B.M.* List II, Fasc. I, p. 26, 1928 as *Beauveria globulifera* (Speg.) Picard. On insects and spiders.
— **densa** (Link ex Sacc.) Picard. E. W. Mason, *Fungi Recd. I.B.M.*, List I, p. 7, 1925; **28** (XVI, 60; XVII, 175; XVIII, 4); **35** (1932, 167); **76** (III, 63) as *Isaria*. On insects and spiders. The transfer to *Beauveria* was apparently first made by Picard in *Ann. Serv. Épiph.* I, 160, 1913.
Botryosporium diffusum (Alb. & Schw. ex Fr.) Corda. **18**, 354; **15**, 617; **13**, 286; **48** (V, 234); **14** (XVI, 59); **8**, 291*; **33** (XIV, 31*, on *Tradescantia*); **7**, 329; Cooke Exs. I, No. 353. As *Botrytis*: *Mem. Wern. Nat. Hist. Soc.* I, 72*, 1822; **51**, 468; **39**, t. 126, 1825. [**20**, 341, 1836 as *Stachylidium* was *Botryosporium pulchrum*]. On dead plants.—See E. W. Mason, *Annotated Acc.* List II, Fasc. I, p. 27, 1928, on *Botryosporium*. He points out that *B. diffusum* is uncertain.
— **foecundissimum** (Sacc. & March.) Massee & Salm. in **33** (XVI, 81*, 1902). On dung of giraffe, 'Kew'. As *Cladorrhinum*: **82** (XII, 43). Reported with doubt from cucumber roots.
— **longibrachiatum** (Oudem.) Maire. E. W. Mason (op. cit.). On dying *Dracaena*, England.
— **pulchrum** Corda. **68A** (V, 117, 1857); **18**, 354; **15**, 617*, **46** (III, 136); **8**, 292; **28** (III, 35*); **7**, 329. On old herbs. See *B. diffusum*.
— **pyramidale** (Bon.) Cost. **35** (1936, 275, on *Mercurialis*). As *Botrytis*: **28** (V, 414*, 1917); **34** (XVII, 288). On wood and in soil.—See E. W. Mason, op. cit.
Botryotrichum piluliferum Sacc. & March. **28** (VI, 374, 1920). On sacking, Baslow.
Botrytis aclada Fres. **8**, 319, 1893. On decaying scapes of onion.—This and several other determinations of *Botrytis* are doubtful.
— **Allii** Munn. **22** (Misc. Publ. 52, p. 55, 1926; 70, p. 38; Bull. 79, p. 62); **33** (XLIV, 469 and 557); **56** (LIII, 50); **65** (XXX, 257 and 343); **71** (XLB, 54). On *Allium*. Referred to *B. cinerea* until about 1926.
— **angularis** A. L. Smith in **27** (XXXVI, 181*, 1898); Sacc. XVI, 1033. On moss and soil, Newport, Mon.
— **anthophila** Bondarzew. **28** (XVIII, 239*, 1933); **26A**, Ser. H., No. 4, 1925, as *B. antherarum-Trifolii* Schlecht. In anthers of *Trifolium pratense* throughout Britain.
— **argillacea** Cooke in **14** (III, 183, 1875); Sacc. IV, 125; **8**, 315; **28** (III, 284; VI, 78); Cooke Exs. II, No. 353; Vize Exs. 79. On wood.
— **brevior** (Berk. & Br.) Sacc. in *Syll.* IV, 123; **8**, 315. *Coccotrichum brevius* B. & Br. in **19** (5, VII, 131*, No. 1918, 1881); **14** (XX, 50); **46** (III, 136). On bark.
— **cana** Kunze & Schm. ex Fr. **20**, 342, 1836; **8**, 317; **40** (V, 325); **7**, 332. As *Polyactis*: **15**, 600; **13**, 279; **56** (XI, p. LIII); **23** (III, 283); **27** (XVII, 335); Cooke Exs. 355; Vize Exs. 244. On leaves.
— **capitata** (Berk. & Br.) Sacc. in *Syll.* IV, 132; **8**, 318; *Polyactis* B. & Br. in **19** (5, VII, 131, No. 1919, 1881); **14** (X, 51; XVI, 62). On *Cheiranthus*.
— **cinerea** Pers. ex Fr. The first British record noted as *Botrytis* is Johnston **58**, 212, 1831, 'parasitical on *Sclerotium durum*', then Berk. **20**, 342, 1836. *S. durum* Pers. ex Fr. was recorded by Hooker **92**, 10, 1821; Greville **39**, t. 1,

1823 and **51**, 462; Baxter Exs. 98; Berk. Exs. 74, etc. *Sphaeria solida* Sowerby in **42**, t. 314, 1801, may have been *Sclerotium durum*. For a time *B. cinerea* arising from sclerotia (*S. durum*) was called var. *sclerotiophila* Sacc. e.g. **8**, 318.—The more important British records of *B. cinerea* (some as *Polyactis cinerea* (Pers., Berk.) are amongst the following: **5**, 459; **15**, 601; **22**, numerous records; **23** (III, X, XI, XV, XXIII, XXXIII, XLIII); **25** (XVI, 579; XVII, 600); **28** (VIII, 115; XIV, 118; XVI, 309; XVII, 331; XX, 299); **32** (XVI, 109; XXIII, 78); **33** (II, XVIII, XXII, XXIX–XXXII, XXXVI–XXXVIII, XLI, XLIV, XLVI, XLVIII, L); **34** (X, 335; XVII, 288; XXV, 92); **37** (1916–18); **64** (XLVII, 20); **65** (XXX, 59); **66** (CXCVIIB, 7; CCXB, 83; CCXXB, 99); **67** (LXXIII, 118; CII, 427 and 444; CV, 375; CXI, 210); **70** (XIX, 562); numerous records in **77**; **78**; **79**; **85**; **89**; **93**; **104** (VII, 237); **102** (VIII, 167); Cooke Exs. II, No. 342. As *B. Douglasii* Tubeuf on conifers: **28** (I, 25; VII, 85); **64** (XV, 320; XXXIV, 223; XXXV, 77); **89**, 226. Common on numerous hosts. A. Lorrain Smith **27** (XLI, 19, 1908), reported apothecia in Britain. See also **100** (XXXI, 485).

Botrytis citrina Berk. in **19** (1, I, 262*, No. 127, 1838); **15**, 592*; Sacc. IV, 122; **8**, 315. On fallen cherry branches.

— **convoluta** Whetzel & Drayton. Reported **100** (XXIV, 476, 1932) on rhizomatous *Iris* from England.

— **corolligena** Cooke & Massee in **14** (XVI, 10, 1887); Sacc. x, 536; **8**, 314. On *Calceolaria* flowers, Kew.

— **Croci** Cooke & Massee in **14** (XVI, 10, 1887); Sacc. x, 536; **56** (XXVII, 394); **89**, 71; see **22** (Bull. 117, p. 149). On *Crocus*.

[— **curta** Berk. in **19** (1, I, 262, No. 128, 1838) is *Plasmopara pygmaea*.]

— **dichotoma** Corda. **68A** (1877, 191); **48** (1900, 98); **28** (I, 151). On decaying tulip stem near Dublin.

— **elliptica** (Berk.) Cooke in **56** (XXVI, p. cxxix); **22**, Bull. 117, with references; see also *Lily Year Book* 1933, 194; **79** (VI, VII, XI); **71** (XLII, 53). *Ovularia* Berk. in **31** (2, XVI, 340*, 1881); **19** (5, IX, 183, No. 1980, 1882); **14** (X, 51; XVI, 62); **33** (II, 319, 1888) as *Botrytis* (*Polyactis*) sp. On *Lilium*.

— **fascicularis** (Corda) Sacc. **8**, 318; **7**, 333. As *Polyactis*: **73** (1870, t. 6); **15**, 601; **13**, 279; Vize Exs. 572. As *Penicillium fasciculatum* Sommerf.: **19** (1, 262, No. 129, 1838); Berk. Exs. 310. This is doubtless *B. cinerea*.

— **galanthina** (Berk. & Br.) Sacc. in *Syll.* IV, 136; **22**, Bull. 117, with references; **8**, 320; **56** (LIII, 49); *Polyactis* B. & Br. in **19** (4, XI, 346, No. 1385, 1873). On *Galanthis nivalis*.

— ?**Gladioli** Kleb. **22** (Bull. 117, 1939). On *Gladiolus*.

— **gonatobotryoides** Cooke & Massee in **14** (XVI, 79, 1888); Sacc. x, 536; **8**, 314. On *Hypericum calycinum*, Kew.

— **grisella** Sacc. **28** (III, 224, 1910) as *B. griseola* Sacc. On wood, Kew.

— **Hyacinthi** Westerd. & van Beyma. **22** (Bull. 117, 14, 1939). On *Hyacinthus*.

— **isabellina** Preuss. **27** (L, 13, 1912). On pine bark, Lincs.

— **narcissicola** Kleb. **22** (Bull. 117, 67) with references; **79** (IX–XI); **56** (LIII, 48); **65** (XXX, 347). On *Narcissus*.

— **Paeoniae** Oudem. **31** (3, XXIV, 124*, 1898); **5B**, 157; **89**, 19*; **28** (VI, 371); **112**, 141; **93**, 194; **35** (1923, 250); **79** (VII, 20 and 35; XI, 56). On *Paeonia*.

— **pilulifera** Sacc. **33** (XVI, 81*, 1902). On fowl's dung, Kew.

— **polyblastis** Dowson in **28** (XIII, 102*, 1928); **22** (Bull. 117, 69) with references: **79** (V–XIII). On *Narcissus*, stage of *Sclerotinia polyblastis* Gregory in **28** (XXII, 202).

— **trabea** (Berk. & Br.) Sacc. in *Syll.* IV, 117; **8**, 314; *Stachylidium* B. & Br. in **19** (5, VII, 131*, No. 1920, 1881). On wood, King's Cliffe.

— **tricephala** (Phill.) Sacc. in *Syll.* IV, 135; **8**, 319; *Acmosporium* Phill. in **31** (2, XXI, 317*, 1884). On *Cryptomeria japonica*.—Barnes, *Rep. Proc. Imperial Bot. Conf. London*, 1924, p. 346, 1925, reports an *Acmosporium* stage of a *Lachnea*.

— **truncata** (Cooke) Sacc. **28** (VI, 370, 1920). On wood, Woolwich.

— **Tulipae** (Lib.) Lind. **22** (Bull. 117, 20) with references, some as *B. parasitica* Cav. and *B. vulgaris* Fr.; **79** (III–XII); **85** (XXIX); **56** (LIII, 48); **65** (XXX, 59 and

348); **33** (xxxvi, 262 and 294) as *B. parasitica* from onion; **77** (1924, 111). On *Tulipa* (and onion?).

Botrytis vera Fr. **20**, 342, 1836; **68** (1901, 615); **28** (i, 184); **8**, 317. *Polyactis vera* (Fr.) Berk. in **18**, 350; **15**, 600; **111**, t. 132, 1789 as *Mucor Botrytis.* On *Polyporus*, etc.; probably *B. cinerea.*

— **violacea** Grove in **27** (l, 13*, 1912); Sacc. xxv, 695. On rotten wood and humus, Warwicks.

— **virella** Fr. **14** (xvi, 61, 1887); **8**, 315; **7**, 332. On old wood.

— **vulgaris** Fr. **20**, 342, 1836; **31** (1886, 173); **8**, 316, with four 'varieties'. As *Polyactis*: **120**, 554, 1821; **15**, 600*, and other early records. Generally considered to be *B. cinerea.*

Briarea elegans Corda. **8**, 303*; **7**, 331. *Aspergillus penicillatus* Grev. in **39**, t. 32, 1823; **51**, 467. *Monilia penicillata* Fr. in *Syst.* iii, 410 ('penicillata' is thus the valid specific epithet); **20**, 344. As *M. 'fasciculata* Corda': **18**, 351; **15**, 106*; **13**, 281. On old grass.

Camptoum curvatum Link ex Corda. **19** (2, vii, 100, No. 518, 1851); **15**, 586*; **73** (1877, t. 27); **13**, 274; **8**, 372*; E. W. Mason, *Annotated Acc.* List ii, Fasc. 2; Berk. Exs. 310. On *Scirpus*, etc. Fries compiled this species under *Arthrinium.*

Catenularia simplex Grove gen.nov. in Sacc., *Syll.* iv, 303, Apr. 1886 and **27** (xxiv, 201); **8**, 380. On wood, Staffs. See E. W. Mason, *Annotated Acc.*, List ii, Fasc. 3.

Chaetopsis grisea (Ehrenb. ex Fr.) Sacc. *C. Wauchii* Grev. gen.nov. in **39**, t. 236, 1823; **18**, 353; **15**, 614*; **13**, 285; **8**, 385*; **20**, 337 as *Dematium griseum* Pers. On wood.

Chromosporium aureum (Corda) Sacc. **7A**, 296, 1904; **7**, 327; **37** (1909, 376). On old rug, etc.

— **lateritium** (Berk. & Br.) Sacc. in *Syll.* iv, 7; **8**, 275*; *Gymnosporium* B. & Br. in **19** (5, vii, 129, No. 1903, 1881); **14** (x, 49; xvi, 57). On elm bark.

— **rubiginosum** Cooke & Massee in **14** (xvi, 78, 1888); Sacc. x, 511; **8**, 276. On leaves, Scotland.

Cladosarum olivaceum Yuill & Yuill gen.nov. in **28** (xxii, 199*, 1938). From a culture of *Aspergillus niger*; perhaps a mutant.

Coniosporium carbonaceum Cooke & Massee in **14** (xvi, 79, 1888); Sacc. x, 569; **8**, 357. On *Spiraea.*—The genus *Coniosporium* is based on *C. olivaceum* Link ex Fr.; Mason, *Annotated Acc.* List ii, Fasc. 2, found the type specimen to be dictyosporous. *C. olivaceum* was described very vaguely; Mason found the specimen to resemble that figured as *Sporidesmium Peziza* Cooke & Ellis in **14** (iv, 178*). Cooke recorded *C. olivaceum* from Scotland, **14** (xvi, 96), but Massee's description, **8**, 357, shows it to have been something else. Perhaps *Coniosporium* Sacc. 1880 should be conserved against *Coniosporium* Link ex Fr. Meanwhile we include two species under *Coniosporium*, and two under *Papularia.*

— **Physciae** (Kalchbr.) Sacc. **14** (iv, 119, 1876); **8**, 357; **119**. On *Physcia*, Norfolk.

Coremium coprophilum Berk. & Curt. Listed **14** (xvii, 9, 1888). On rabbit dung, Kew. *Coremium* is *Penicillium* with coremia.

— **niveum** Corda. **40** (ix, 172, 1887). On a rhizome, Scotland.

— **vulpinum** Cooke & Massee in **14** (xvi, 81, 1888); Sacc. x, 687. On wolf's dung, locality unknown.

Cristulariella depraedens (Cooke) von Höhnel gen.nov. in *Frag. Myk.* No. 997, 1916; *Polyactis* Cooke in **73** (ii, 141*, 1885). *Botrytis* Sacc. in *Syll.* iv, 134; **8**, 319; **89**, 201*; **5**, 460. On leaves of *Acer Pseudoplatanus.* See also ref. in *Rev. Appl. Myc.* ix, 690.

Cylindrium cylindricum (Corda) Lindau. **28** (iii, 147). *C. Cordae* 'Grove nec Sacc.' in **27** (xxii, 196). As *C. Cordae* Sacc.: **8**, 284; **7**, 328. As *Fusidium*: Vize Exs. 334. On oak leaves.

— **flavovirens** (Ditm. ex Fr.) Bon. **8**, 285; **7**, 328. As *Fusisporium*: **20**, 351; Berk. Exs. 213. As *Fusidium*: **39**, t. 102. 1824; **51**, 464; **58**, 209; **15**, 609; **13**, 283;

Vize Exs. 139. As *Cylindrium aeruginosum* (Link) Lindau: **28** (v, 17); **71** (xl, 54). As '*Fusidium sulphureum* Link': **14** (xvi, 58), see **8**, 282. On fallen leaves.

Cylindrium griseum Bon. **37** (1907, 242); **28** (iii, 147, 223 and 247); **70** (1936, 410). On leaves.

— **heteronemum** Sacc. **71** (xxviii, 148), Ireland. Recorded as British in Sacc. iv, 38, but in error as his reference shows; **14** (xvi, 58) and **8**, 285 may be based on Saccardo's entry.

Cylindrodendrum album Bon. Recorded **28** (xx, 4, 1935; xxii, 218). On catkins.

Dematium hispidulum Fr. **20**, 338, 1836; **19** (1, vi, 435, No. 231); **8**, 382*. As *Sporodum conopleoides* Corda: **15**, 585*; **40** (ii, 311; v, 324); **13**, 274; Vize Exs. 69. On dead grasses.

— **vinosum** Massee in **14** (xxi, 7*, 1892); Sacc. xi, 614; **8**, 383. On paper.

Dematophora necatrix Hartig. **89**, 161*; **112**, 173; numerous records as *Rosellinia*, a stage not yet found in Britain: see list in **28** (xxiv, 155). On *Pyrus*, etc. See E. W. Mason, *Annotated Acc.* List ii, Fasc. 3.

Echinobotryum atrum Corda. **19** (2, v, 460, No. 457 bis, 1850); **15**, 487*; **40** (viii, 189); **71** (2, iv, 26); **8**, 365*; **7**, 337; **34** (xvii, 292*); Mason, *Annotated Acc.* List ii, Fasc. 2; Berk. **19** (1, i, 260, No. 124, 1838) as *Dematium echinobotryum* Fr. Reported 'on *Stysanus*' etc.: the *Echinobotryum* and the *Stysanus* are two states of the same fungus.

— **leve** Sacc. **27** (xxiv, 200, 1886); **8**, 366; **34** (xvii, 292*, 'on *Stysanus*'). In soil, etc.

Fusidium Asteris Phill. & Plowr. in **14** (vi, 23, 1877); Sacc. iv, 29; **8**, 282. On leaves of *Aster*.

— **Deutziae** Cooke in **14** (xvi, 48, 1887); Sacc. x, 516; **8**, 282; **89**, 193*. On *Deutzia*, London.

— **griseum** Link ex Wallr. **120**, 544, 1821; **39**, t. 102, 1823; **51**, 464; **15**, 609; **40** (v, 9); **14** (xvi, 57); **8**, 282; **7**, 328; **71** (xxviiib, 148); Vize Exs. 140; Cooke Exs. 198; **20**, 352 as *Fusisporium*. On leaves.

— **lycotropum** Preuss. **27** (xxiv, 198, 1886); **8**, 282. On stems, Warwicks.

— **maritimum** Sutherl. in **32** (xv, 41*, 1916); **28** (v, 430); Sacc. xxv, 644. On *Laminaria* and *Pelvetia*, Orkney and Dorset.

— **viride** Grove in **27** (xxiii, 164*, 1885); Sacc. iv, 26; **8**, 281; **27** (lvi, 344); **7**, 327; **34** (xvii, 288). On stems, etc.

Geotrichum candidum Link ex Sacc.? **8**, 289, 1893; **35** (1914, 149); **71** (xl, 54). On soil, etc. Loubière, *Thèses Fac. Sci. Paris*, 1924, and some other mycologists consider *G. candidum*, the type species of the genus, a synonym of *Oospora lactis*, i.e. that *Geotrichum* is one of the Gloiosporae.

— **matalense** (Castellani) Castellani var. **Chapmani** Castellani in *J. Trop. Med. Hyg.* Sept. 15, 1932*; *Oidium* sp. in **28** (xiv, 291*). In sewage. Dodge, *Medical Mycology*, refers it to *Pseudomonilia*.

— **roseum** Grove in Sacc. *Syll.* iv, 40, Apr. 1886 and **27** (xxiv, 198*); **27** (l, 11); **87** (xii, 165); **22**, Bull. 79. On the ground. Sydow made this the type of a new genus *Allonema* in **102** (xxxii, 283, 1934).

Gibellula aranearum (Schwein.) Syd. **28** (xvii, 176, 1932). On spiders.

[**Glenospora Curtisii** Berk. & Desm. **71** (xxviii, 149, 1910). Ireland. A *Septobasidium*. See **28** (xii, 105) and Couch's Monograph.]

Gonatobotrys flava Bon. **14** (xvi, 63, 1887); **8**, 333*; **28** (vi, 87). On wood etc.

— **simplex** Corda. **18**, 354, 1860; **15**, 616*; **27** (xxxv, 8); **8**, 333; **7**, 334; **71** (xliib, 53). On old plants.

Gonatorrhodiella Highlei A. L. Smith in **28** (iii, 36*, 1908); Sacc. xxii, 1302. On bulbs, London.

— **parasitica** Thaxt. **28** (xxi, 11, 1937). On *Hypomyces*, Devon.

Gonatosporium puccinioides (DC. ex Fr.) Corda. **19** (2, vii, 100, No. 519, 1851); **15**, 585*. As *Arthrinium*: **19**, No. 236; Berk. Exs. 311. As *Goniosporium*; **8**, 374*; **7**, 338*; *Torula Eriophori* Berk. in **20**, 359, 1836. On *Carex*, etc.

Graphiopsis chlorocephala (Fres.) Trail gen.nov. in **40** (x, 75, 1889); **40** (x, 281). *Haplographium chlorocephalum* (Fres.) Grove in **60** (xxi, 198*, 1885); **40** (ix, 172); **27** (xli, 259*); **28** (ii, 74). On *Carex*, etc.

— **Desmazierii** (Sacc.) von Hohnel. As *Graphium*: **14** (xvii, 11, 1888); **8**, 455. On wood, stage of *Rosellinia Desmazierii* (B. & Br.) Sacc. This is *Graphiopsis* Bainier, which is antedated by *Graphiopsis* Trail (above); it is a good *Dematophora*.

Graphiothecium parasiticum (Desm.) Sacc. **14** (xvii, 11, 1888); **8**, 459*; **37** (1907, 244). On old leaves.

Gyroceras Plantaginis (Corda) Sacc. **14** (xvi, 97); **8**, 365*. As *Torula*: **19** (i, vi, 439, No. 252, 1841); **15**, 478. On *Plantago*. Linder **101** (xviii, 5) transferred it to *Helicoceras*.

Hadrotrichum anceps Sacc. **28** (vi, 373, 1920). On *Arrhenatherum elatius*, Wisley.

— **microsporum** Sacc. & Malbr. **40** (ix, 41, 1887) as 'var. *majus*' (a nomen nudum). On *Agrostis*.

— **virescens** Sacc. & Roum. **28** (v, 243, 1916); **27** (lx, 176*); **71** (xlii, 54). On *Agrostis*.

— **virescens** var. **Poae** Sacc. **27** (lx, 176, 1922); **28** (viii, 253). On *Poa*.

Haplaria grisea Link ex Chev. **120**, 552, 1821; **15**, 599*; **13**, 278; **8**, 304*; **7**, 331; **71** (xxviii, 148); **20**, 342, 1836 as *Botrytis*. On *Sparganium*, etc.

Haplobasidium pavoninum von Höhnel. **28** (xxii, 266*, 1939). On *Aquilegia*, Scilly.

Harpographium graminum Cooke & Massee in **14** (xvi, 81, 1888); Sacc. x, 696; **8**, 458*. On straw, Hampstead.

— **rhizomorphum** (Mont.) Sacc. As *Graphium*: **7A**, 300, 1904; **7**, 346. On rhizomorphs of *Armillaria mellea*, Yorks.

Hormiscium callisporum Grove in **27** (l, 16*, 1912); Sacc. xxv, 765; **27** (liv, 221). On Umbelliferae.

— **Centaurii** (Fuckel) Sacc. **28** (iv, 327, 1914). On *Erythraea*, Kent.

— **laxum** Wallr. **70** (1936, 416). On *Urtica*, Ireland.

— **pinophilum** (Nees ex Fr.) Lindau. **70** (1936, 416). As *Torula*: **14** (iv, 119); **40** (iii, 317); Cooke Exs. ii, No. 335. As *H. pithyophilum*: **8**, 364; **35** (1915, 147). On conifers. *H. pithyophilum* var. *myrmecophilum* Bayliss Elliott was proposed in **28** (v, 139, 1915), on ants' nests.

— **splendens** (Cooke) Sacc. in *Syll.* iv, 264; **8**, 364*. *Torula* Cooke in **14** (iii, 178*, 1875); **13**, 229; **40** (iii, 317; iv, 347); **28** (iv, 205). On bark.

— **stilbosporum** (Corda) Sacc. **14** (xvi, 97); **40** (ix, 172; x, 281); **8**, 364. As *Torula*: **15**, 477, 1871; Vize Exs. 116. On branches.

Hormodendrum chartarum (Cooke) Grove in **74** (vi, 47, 1911); *Penicillium* Cooke (sine diag.) in **59** (1871, 11*); **15**, 602. *Haplographium* Sacc. in *Syll.* iv, 305; **8**, 381; **35** (1912, 92). On wall-paper, London.

— **Hordei** Bruhne. **28** (iii, 35, 1908); **5**, 466; **23** (xviii, 670); **35** (1909, 419). On barley, melons, etc.—Doubtless a form of *Cladosporium herbarum* (see *Flora Italica*).

— **Hordei** var. **parvispora** A. L. Smith in **28** (iii, 35*, 1908). On paper, Hants.

— **olivaceum** (Corda) Bon. **28** (ix, 187, 1924). On old plums.

Hyalodendron album (Dowson) Diddens, gen.nov. in *Zentralbl. Bakt.* 2, xc, 316, 1934. *Cladosporium* Dowson in **56** (xlix, 221*, 1924); **112**, 337; **85** (xxviii, 50); **79** (vi, 18; vii, 20 and 36; xi, 58, the last two pages as *Erostrotheca*). On *Lathyrus*, etc.—*Erostrotheca multiformis* Martin & Charles was described as the perfect stage in America in **99** (xviii, 844); not reported in Britain.

Hymenostilbe arachnophila (Ditm. ex Fr.) Petch in **35** (1931, 249); **28** (xvii, 176). As *Isaria*: **19**, No. 117; **15**, 548; **8**, 447; **7**, 345. On spiders.—Petch later **28** (xviii, 75) considered *Hymenostilbe* Petch probably a synonym of *Akanthomyces* Lib.

— **muscaria** Petch gen.nov. in **35** (1931, 101); **28** (xvii, 176); **35** (1932, 133). On flies; conidial stage of *Cordyceps Forquignoni* Quél., **28** (xxi, 298).

Hymenostilbe sphecophila (Ditm. ex Fr.) Petch in **28** (XXI, 55, 1937); **28** (XXI, 298). As *Isaria*: **31** (XVII, 378*, 1882); **33** (IX, 16); Cooke, *Veg. Wasps*, p. 50*; **28** (XVII, 177). On *Hymenoptera*, stage of *Cordyceps sphecocephala*.

Hyphoderma roseum (Pers. ex Fr.) Fr. **14** (XVI, 60); **8**, 304. As *Hyphelia*: **40** (II, 280, 1874). On wood.

Isaria albida (Fr.) Sacc. **8**, 449; **7**, 345. *Pachnocybe albida* (Fr.) Berk. in **20**, 335, 1836; **15**, 551; Berk. Exs. 52. On wood. See Petch **28** (XIX, 34) on *Isaria*. If the genus *Isaria* is to be retained, the third species of Fries's *Systema*, *I. farinosa*, should be chosen as lectotype.

— **brachiata** Batsch ex Fr. **19** (1, I, 49, No. 30, 1837); **15**, 548; **40** (VIII, 228); **8**, 448; **7**, 345; **28** (XXI, 66). On old fungi, etc.

— **citrina** Pers. ex Fr. **19** (1, I, 49, No. 31, 1837); **15**, 548; **13**, 263; **8**, 449; **7**, 345. On fungi, etc.

— **clavata** Ditm. ex Fr. **8**, 450, 1893. On wood.

— **cretacea** van Beyma in *Zentralbl. Bakt.* 2, XCI, 350*, 1935. From a packet of yeast, Surrey.

— **dubia** Delacr. **35** (1932, 133); **28** (XVII, 176; XVIII, 67; XXI, 297). On insects; a stage of *Cordyceps gracilis*.

— **farinosa** Fr. **20**, 328; **15**, 770*; **8**, 447*; Cooke, *Veg. Wasps*, p. 178*; **33** (IX, 4); **23** (XX, 25); **71** (XXVIII, 150); Ramsbottom, *Handbook Larger British Fungi*, p. 192; **28** (XVII, 175; XIX, 38; XX, 12, 38 and 216); **35** (1932, 107). *Clavaria farinosa* (Holmsk.) Dickson in **44** (II, 25, 1790); **42**, t. 308; **38** (IV, 338). **120**, 562 as *I. crassa* Link; **14** (XVII, 9); **120**, 562 as *I. velutipes* Link. On insects.

— **felina** Fr. **19** (3, XV, 402, No. 1050, 1865); **15**, 548; **8**, 448; **40** (V, 34; VII, 54); **7**, 345. On dung of cats and dogs.

— **Friesii** Mont. **19** (2, V, 464, No. 491, 1880); **15**, 549; **8**, 449; **7**, 345. On bark.

[— **fuciformis** Berk. **8**, 450; **89**, 241*; **31** (1873, 596); **81**, 57*, etc. This is *Corticium fuciforme* (Berk.) Wakef.]

— **intricata** Fr. **19** (1, I, 259, No. 118, 1838); **15**, 549; **13**, 263; **40** (VII, 271); **8**, 448; **7**, 345; **28** (XXI, 67). On fungi.

— **leprosa** Fr. **28** (XVII, 175, 1932; XVIII, 68); **35** (1932, 108). On insects; it may be *I. farinosa* parasitized by *Sporotrichum Isariae*.

— **muscigena** Cooke & Muller in **14** (XVI, 81, 1888); Sacc. X, 690; **8**, 449. Amongst moss, Eastbourne.

— **puberula** Berk. in **19** (1, VI, 432*, No. 221, 1841); Sacc. IV, 595; **15**, 549; **8**, 450. On old flowers of *Dahlia*, Northants.

— **Sphingum** Schwein. ex Fr. **19** (5, I, 27, No. 1710, 1878); **13**, 263; **8**, 447; **33** (IX, 35); **35** (1932, 108). On insects. Petch **28** (XVIII, 75) considers that all European records should be assigned to *Akanthomyces aculeata*, q.v.

— **spumarioides** Cooke in **14** (IV, 69, 1875); Sacc. IV, 592; **8**, 450. On bark, Knowsley.

— **sulphurea** Fiedler. **27** (XXIV, 205, 1886); **8**, 448; **33** (XVI, 86); **7**, 345. On dung of various animals.

— **tomentella** Fr. **19** (5, I, 27, No. 1711, 1878); **14** (VI, 126); **8**, 450. On wood, etc.

— **umbrina** Pers. ex Wallr. **20**, 236, 1836; **114** (II, 33); **15**, 794; **8**, 449; **35** (1913, 178); Rabenh. Herb. Myc. No. 172, coll. Broome. *Lycoperdon acariforme* Sow. in **42**, t. 146, 1798. *Institale acariforme* Fr. in *Systema*; **28** (XVI, 147). On *Hypoxylon coccineum*; probably its conidial stage. See *Trichosporium Tulasnei*.

Martensella pectinata Coemans. **28** (VI, 371, 1920). In soil, Herts.

Memnoniella echinata (Rivolta) Galloway in **28** (XVIII, 165*, 1933). From cotton yarn.

Meria Laricis Vuill. **5**, 462, 1910; **28** (VII, 10; XIV, 181); **94** (XV, 57); Hiley, *Diseases of the Larch*; **112**, 352; *Oxford Forestry Memoir*, No. 15, 1933; **76** (VI, 113; X, 79); **71** (XLB, 55). On *Larix*.

Metarrhizium Anisopliae (Metsch.) Sorok. **35** (1932, 167); **28** (XVI, 67; XVII, 174). On insects.

Monilia aurea Gmelin ex Sacc.? **48** (V, 234); **8**, 283. As *Oidium*: **20**, 348, 1836; **15**, 603; **13**, 280; **7**, 328; Vize Exs. 251. As *M. hesperidica* Sacc.: Cooke Exs. II, No. 632; Vize Exs. 142. On bark, etc.

— **candicans** Sacc. **28** (II, 32, 1903); Grove **27** (LVIII, 250) considered *M. caespitosa* Purton to be synonymous. On old wood.

— **candida** Bon. **35** (1920, 403). On an owl pellet, Yorks.

— **cinerea** Bon. **33** (XXXIII, 361*, 1919; XXXIV–XXXVI, XLIV); **104** (IV, VII, IX, XI–XIII); **33** (XXXVI, 262); **70** (1928, 63*); **96** (III, 130); **65** (XXX, 339); **79** (I); **93**, 134. On *Prunus*, *Pyrus*, etc., stage of *Sclerotinia laxa* Aderh. & Ruhl. f. *Mali* (Wormald) Harrison.

— **Crataegi** Died. **28** (XXII, 206, 1939). On *Crataegus*. As *Sclerotinia*: **77** (1926/27, II, 86, 1928); **31** (CI, 426; CII, 47).

— **fructigena** Pers. ex Westend.? **8**, 283; **5B**, 300 and 434; **56** (XIX, XXIII, XXV, XXVI, XXVII); **7**, 328; **89**; **93**; **66** (1905, 7); **78** (1915, 1916, 1919); **33** (XVIII, XIX, XXXIII, XXXIV, XXXVI, XLI, XLIV, XLVII, XLVIII, L); **28** (X, 109; XV, 102); **79** (I, II); **103** (IV, 76); **104** (II, IX, X, XII). As *Oidium*: **20**, 349, 1836; **15**, 604; **13**, 280. On apples, etc., stage of *Sclerotinia fructigena* Aderh. & Ruhl.

— **glasti** Plowr. in **27** (XXXIX, 385, 1901); Sacc. XVIII, 501. On wood, Cambs.

— **humicola** Oudem. var. **brunnea** A. L. Smith in **28** (III, 120, 1909); Sacc. XXII, 1245. On wood, Scotland.

— **Koningi** Oudem. **28** (II, 32, 1903). From Scotland.

— **pruinosa** Cooke & Massee in **14** (XVI, 78, 1888); Sacc. X, 518; **89**, 169; **34** (XVII, 289*). On old leaves of *Caladium* and in soil.

— **racemosa** Pers. ex Fr. **20**, 345; **15**, 606; **48** (II, 259). *M. caespitosa* Purton in **55** (III, 320*, 1821); **8**, 284. **38** (II, 784, 1776) as *Mucor caespitosus*; **111**, t. 132. On decaying vegetation. See *M. candicans*.

— **sitophila** (Mont.) Sacc. **35** (1912, 88); **27** (LXIX, 67); **28** (XIX, 215); **116**, 91. *Oidium Lupuli* Matth. & Lott in *Microscope in Brewery and Malthouse*, p. 86, 1899; *Monilia Lupuli* (Matth. & Lott) Massee ex Grove in **74** (VI, 42*, 1911); **34** (XVII, 289) as '*Oospora Lupuli*'. *Oidium aurantium* Cooke in **14** (I, 21, 1872); Cooke Exs. 448; *Oospora aurantia* (Cooke) Sacc. & Vogl. in *Syll.* IV, 22; **14** (XVI, 57); **8**, 280. On spent hops, etc.; stage of *Neurospora*.

— **tetrasperma** Ramsb. & Steph. nom.nov. in **28** (XIX, 218*, 1935). From charred *Ulex*, Woolwich; stage of *Neurospora*.

Monosporium coprophilum Cooke & Massee in **14** (XVI, 10, 1887); Sacc. X, 535; **14** (XVI, 61); **8**, 311. On dung, Kew.

— **maritimum** Sutherl. in **32** (XV, 42*, 1916); Sacc. XXV, 692; **28** (V, 430). On old *Laminaria*, Dorset.

— **olivaceum** Cooke & Massee in **14** (XVI, 78, 1888); Sacc. X, 535; **8**, 311*; **35** (1905, 189); **7**, 371. On bark.

— **saccharinum** Berk. & Br. in **19** (4, XI, 345*, No. 1379, 1873); Sacc. IV, 116; **14** (II, 137; XVI, 61); **8**, 311. On decayed substances, Batheaston.

Monotospora affinis A. L. Smith & Ramsb. in **28** (V, 167, 1915); Sacc. XXV, 772. On wood, Scotland.—See E. W. Mason, *Annotated Acc.* List II, Fasc. 3 for *Monotospora*.

— **asperospora** Cooke & Massee in **14** (XVI, 79, 1888); Sacc. X, 588; **8**, 378. On dead *Clematis*, Shere.

— **Daleae** Mason nom.nov. in *Annotated Acc.* List II, Fasc. 2, p. 50*, 1933. '*Basisporium gallarum*?' in **102** (X, 466*, 1912); **28** (IV, 184; XII, 153); Mason, op. cit. Fasc. I, 25. From soil.

— **megalospora** Berk. & Br. in **19** (2, XIII, 462*, No. 759, 1854; Sacc. IV, 299; **15**, 568*; **13**, 269; **40** (II, 310; IX, 172); **8**, 378; **46** (II, 215); **7**, 339. On bark.

— **megalospora** var. **fusispora** Sacc. in *Syll.* IV, 299; **8**, 378; **19** (3, VII, 381, No. 943, 1861) as 'a form...with broadly fusiform spores.' On a stump.

— **pumila** (Massee) Sacc. in *Syll.* IV, 300; **8**, 377*; **7**, 388. *Helminthosporium* Massee in **68** (2, V, 758*, 1885). On *Graphium* and wood.

— **repens** (Cooke) Massee in **8**, 377, 1893. *Periconia* Cooke in **14** (XVI, 79, 1888); Sacc. X, 578. On stems.

Monotospora sphaerocephala Berk. & Br. in **19** (3, III, 361*, No. 819, 1859); Sacc. IV, 299; **15**, 569; **73** (1877, t. 24); **14** (IV, 82; XVI, 98); **48** (V, 9); **8**, 377; **7**, 338; Mason, *Annotated Acc.* List II, Fasc. 2. On wood.

Nematogonium aurantiacum Desm. **15**, 589*; **46** (II, 216); **8**, 333*; **7**, 334; Vize Exs. 337. *Aspergillus aurantiacus* (Desm.) Berk. in **19** (1, VI, 436*, No. 237, 1841); Berk. Exs. 272. On bark.

— **aureum** (Berk.) Berk. in **18**, 348, 1860; Sacc. IV, 170; **15**, 590; **13**, 275; **8**, 334. *Aspergillus* Berk. in **20**, 340, 1836; **19**, No. 237. On bark.

— **humicola** Oudem. **102** (X, 466*, 1912); **28** (IV, 183). From soil, Woburn.

Nigrospora sphaerica (Sacc.) Mason in **28** (XII, 158, 1927). *Hadrotrichum arundinaceum* Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 588; **14** (XVI, 97); **8**, 378*. On *Arundo*, Kew.

Oedocephalum clavatum A. L. Smith in **27** (XLI, 259*, 1903); Sacc. XVIII, 508; **28** (II, 60). From a hyacinth root.—See also *Rhopalomyces*.

— **glomerulosum** (Bull. ex Fr.) Sacc. **28** (I, 151, 1901; II, 57); **33** (XVI, 80*); **27** (L, 12*); **7**, 329. *O. roseum* Cooke in **14** (I, 184, 1873); Sacc. IV, 48; **14** (II, 139*); **8**, 289; Cooke Exs. 550. On dung, etc. See Thaxter, *Bot. Gaz.* XVI, 17, and Matruchot, *Recherches sur les développements de quelques Mucidinées*, 1892.

— **laeticolor** Berk. & Br. in **19** (3, XV, 403*, No. 1056, 1865); Sacc. IV, 48; **15**, 566*; **8**, 289*; **28** (II, 141). On dung.

— **ochraceum** Massee & Salm. in **33** (XVI, 80*, 1902); Sacc. XVIII, 509. On rabbit dung, Kew.

— **Preussii** Sacc. **14** (XVI, 59, 1887); **8**, 290; **27** (XXXV, 8). On old stems.

— **sulphureum** Cooke & Massee in **14** (XVII, 3, 1888); Sacc. X, 521; **8**, 290. On old rope.

Oidium erumpens Cooke & Massee in **14** (XVI, 49, 1887); Sacc. X, 520; **8**, 287; **89**, 60*. On leaves of *Rivea*, Kew.—*Oidium* stages known to belong to Erysiphaceae are omitted here. *O. erumpens* is doubtful.

[— **pactolinum** Cooke in **14** (XII, 99, 1884); Sacc. IV, 44; **8**, 288; **89**, 167* in error as *Chromosporium*. On *Jasminum*, Isleworth. The type specimen bears no *Oidium*.]

Ovularia Asperifolii (Sacc.) Sacc. **14** (XIII, 51, 1884; XVI, 62); **8**, 323. On *Symphytum officinale*, Norfolk.

— **Berberidis** Cooke in **14** (XIII, 98, 1885); Sacc. IV, 144; **14** (XVI, 62); **8**, 324; **89**, 186*. On *Berberis asiatica*, Kew.

— **Bistortae** (Fuckel) Sacc. **40** (VIII, 228, 1886; X, 67); **27** (XXXVI, 182); **28** (III, 120); **35** (1937, 287). On *Polygonum Bistorta*.

— **carneola** Sacc. **40** (IX, 41, 1887; X, 66). On *Scrophularia nodosa*, Scotland.

[— **Clematidis** Chitt. ex Cooke belongs to the Erysiphaceae.]

— **decipiens** Sacc. **40** (X, 281, 1890); **28** (IV, 181); **71** (XLII B, 53). On *Ranunculus acris* and *R. repens*.

— **destructiva** (Phill. & Plowr.) Massee in **8**, 320, 1893; **28** (XIII, 311); **27** (XLVII, 347); **70** (1936, 410); **65** (XXX, 244 and 345). *Ramularia* Phill. & Plowr. in **14** (VI, 22*, 1877); Sacc. IV, 198; **14** (XVI, 64); Cooke Exs. II, No. 538; Vize Exs. 74. On *Myrica Gale*. See *O. rufibasis*.

— **deusta** (Fuckel) Sacc. **71** (XLII, 53, 1934); **70** (1936, 411); **28** (XXII, 218). On *Lathyrus*.

— **duplex** Sacc. Recorded **28** (XXI, 4, 1937 and XXII, 218).

— **epilobiana** Sacc. & Fautr. **70** (1936, 411). On *Epilobium*, Ireland.

— **exigua** (W. G. Smith) Sacc. in *Syll.* XI, 598; **89**, 248; *Peronospora* W. G. Smith in **81**, 12*, 1884. On *Trifolium* and *Lotus*.

[— **Filipendulae** Cooke nomen nudum in **14** (XVI, 62, 1887). On *Spiraea*.]

— **haplospora** (Speg.) Magnus. Recorded **28** (XX, 12) on *Alchemilla arvensis*, Norwich.

— **interstitialis** (Berk. & Br.) Massee in **8**, 322, 1893; **89**, 56*; **35** (1909, 27). *Peronospora* B. & Br. in **19** (4, V, 34, No. 1455, 1875); **13**, 278; **31** (XXV, 564*, 1886); **52**, Ed. 4, 237; *Ramularia* Trail in **40** (VIII, 228, 1886). On *Primula*; perhaps the same as *O. primulana*.

Ovularia Lamii (Fuckel) Sacc. **14** (xvi, 62, 1887); **8**, 324; Cooke Exs. ii, No. 348 as *Ramularia*. On *Lamium*.

— **obliqua** (Cooke) Oudem. in **105** (1883, 85); **8**, 324; **7**, 333; **70** (1936, 411). *Peronospora* Cooke apud B. & Br. in **19** (3, xv, 403, No. 1058, 1865); **15**, 597; **13**, 278; nomen nudum in **52**, 160*, 1865. *Ramularia* Oudem., 1872; **40** (vii, 272). On *Rumex*; stage of *Ovosphaerella Lapathi* (see ref. in *Rev. appl. Myc.* i, 453).

— **ovata** (Fuckel) Sacc. Recorded **28** (v, 7, 1915) as *Ramularia*.

— **primulana** Karst. **40** (ix, 45 and 168, 1887; x, 67); **27** (l, 13*); **28** (v, 363; vii, 10; xix, 9); **48** (xxi, 112); **71** (xlii, 53). On *Primula*. See *O. interstitialis*.

— **rufibasis** (Berk. & Br.) Massee in **8**, 322, 1893; **28** (iv, 37). *Peronospora* B. & Br. in **19** (4, xv, 34, No. 1456, 1875); Sacc. vii, 261; **52** (Ed. 4, 237); **13**, 278. *Ramularia* Trail in **40** (vii, 272, 1884); **40** (x, 67). On *Myrica Gale*. Trail **40** (viii, 228) considered it the same as *O. destructiva*.

— **sphaeroidea** (Sacc.) Sacc. **27** (xxii, 197*, 1884); **40** (viii, 228; x, 66); **28** (iv, 181; xvii, 14); **71** (xlii, 53); Vize Exs. 574. On *Lotus*.

[— **Syringae** Berk. in **31** (xvi, 665*, 1881) is *Phytophthora Syringae* (Kleb.) Kleb.]

— **Veronicae** (Fuckel) Sacc. **40** (x, 66); **8**, 323; **28** (iv, 37; xii, 5); **70** (1936, 411). **19** (5, vii, 130*, No. 1917, 1881) as *Ramularia Veronicae* sp.nov., but Saccardo in *Syll.* iv, 143, considered it the same as *R. Veronicae* Fuckel; **40** (vii, 36; viii, 228); **14** (x, 50; xvi, 62). On *Veronica*.

Pachybasium hamatum (Bon.) Sacc. var. **candidum** Sacc. Recorded **104** (xii, 235, 1934) as *P. candidum* Sacc. in strawberry roots, Surrey.

— **Tilletii** (Desm.) Oudem. **28** (iii, 224 and 316); **27** (lxxiv, 50*). **19** (2, vii, 101, No. 529, 1851) as *Botrytis*; **15**, 591; **8**, 316; **7**, 332; **71** (xxviii, 148). On moss, etc.

Paecilomyces hibernicum Kennelly in **70** (xix, 513*, 1930). In butter, Ireland.

— sp. *Eidamia catenulata* Horne & Williamson in **33** (xxxvii, 430*, 1923); **116**, 87; **66** (ccxxb, 99). In wood. See Thom, *The Penicillia*, p. 545, and Mason, *Annotated Acc.* List ii, Fasc. 3, 89. *Paecilomyces* may perhaps be placed better in the Gloiosporae.

Papularia Arundinis (Corda) Fr. E. W. Mason, *Annotated Acc.* List ii, Fasc. 2, 1933. As *Gymnosporium*: Currey **68A** (1857, t. 8); **15**, 488*; **40** (viii, 190). As *Coniosporium*: **8**, 356*; **70** (xix, 558*). On reeds, etc.

— **sphaerosperma** (Pers. ex Fr.) von Höhnel. E. W. Mason, loc. cit.; *J. Oil Col. Chem. Ass.* xxii, 184. As *Melanconium*: Berk. **19**, No. 251, 1841; **15**, 467; **37** (1918, 171*: see E. W. Mason re Grove's subspecies). *Coniosporium* E. W. Mason in 'List of Cultures, Centralb. Schimmelcult.', July 1931; Grove **1** (ii, 318*); **27** (lxxvi, 359); **40** (x, 281) as *C. Arundinis* var. *phaeospermum*. On reeds, etc.

Penicillium abnorme Berk. & Br. in **19** (5, vii, 130*, No. 1914, 1881); Sacc. iv, 81. On *Trientalis*. Massee **8**, 302, found no specimen. Not a *Penicillium*, teste Thom, p. 575.—Several other British records of *Penicillium* are meaningless. Thom's *The Penicillia* has been examined, and is sometimes cited here as 'Thom'. See also G. Smith, *Industrial Mycology*.

— **asperulum** Bain. **28** (viii, 138, 1923), apparently compiled on p. 140 as *P. 'anomalum'*). On meat.

— **bicolor** Fr. **18**, 350, 1860; **15**, 602; **8**, 302; **7**, 331. On acorn, etc.

— **biforme** Thom. **102** (xii, 39*, 1914); **28** (v, 161). From soil, Woburn.

— **brevicompactum** Dierckx. **70** (xix, 554*, 1930); **66** (ccxxb). In butter, etc.

— **candidum** Link ex Fr. **120**, 554, 1821; **20**, 344; **8**, 300; **75** (xii, 489); **7**, 331; **15**, 602 with var. *Coremium* = *Coremium candidum* Nees; **13**, 280. An uncertain species.

— **carminoviolaceum** Dierckx. **33** (1937, 499). From preserved plants.

— **carneolutescens** G. Smith in **28** (xxii, 253*, 1939). From dried hops.

— **Charlesii** G. Smith in **28** (xviii, 90*, 1933). From maize.

— **chrysogenum** Thom. **28** (x, 111, 1924); **115**, 100; **66** (ccxxb). In apples, etc.

Penicillium citrinum Thom. **66** (CCXXB, 269, 1931); **33** (1937, 509). Sources uncertain.
— **coffeicolor** Berk. & Br. in **19** (4, XVII, 142, No. 1614, 1876); Sacc. IV, 83; **8**, 303. On Pasteur's solution, London. 'Possibly a *Scopulariopsis*', teste Thom.
— **commune** Thom. **66** (CCXXB, 87, 1931); *J. Oil Col. Chem. Ass.* XXII, 184. In building materials, etc.
— **corymbiferum** Westling. Thom, p. 424; **66** (CCXXB); **28** (XVIII, 249); **22**, Bull. 117. In bulbs, etc.
— **crustaceum** Fr. **20**, 344, 1836; **27** (V, 366); **15**, 601; **13**, 279; **74** (VII, 150*); Cooke Exs. II, No. 341. 'Var. *Coremium*' is reported. *Floccaria glauca* Grev. in **39**, t. 301. An unknown species in the same category as *P. glaucum*.
— **crustosum** Thom in *The Penicillia*, p. 399, 1930; **66** (CCXXB). Isolated in Scotland.
— **cyclopium** Westling. **102** (XII, 39*, 1914); Thom, p. 384; **70** (XIX, 555); **28** (XVIII, 250); **22**, Bull. 117. On lily bulbs, etc.
— **decumbens** Thom. **88** (see *Rev. Appl. Myc.* I, 44). On leather.
— **digitatum** Sacc. **66** (CCXXB); **67** (CVB, 375); **104** (IX, 257; X, 184; XII, 315; XIII, 225). On citrus fruits.
— **Duclauxi** Delacr. **66** (CCXXB, 90, 1931). From sand, Scotland.
— **expansum** Link emend. Thom. **120**, 554, 1821; **88** (IV, 88; VI, 165); **22** (Misc. Publ. 33, p. 51); **28** (VIII, 138; X, 110; XXII, 179); **33** (XXXVII, 343); **34** (XXV, 92); **116**, 86 and 102; **79** (IV, V, XI, XII); **78** (1938, 87). On apples, etc.
— **Fieberi** Corda. This unknown species is recorded **53** (XV, 277, 1844) on insects.
— **flavocinereum** Biourge. *J. Oil Col. Chem. Ass.* XXII, 184, 1939. In rain-water, etc.
— **flavoglaucum** Biourge. Reported with the previous species.
— **fuscoglaucum** Biourge. Thom, p. 326; **66** (CCXXB). From 'fuse', Scotland.
— **glabrum** (Wehmer) Westling. **66** (CCXXB, 84); **102** (X, 464, 1912) as *Citromyces*; **74** (VII, 147*, 1912). In soil, beehives, etc.
— **Gladioli** McCull. & Thom. **22** (Bulls. 70, 79, 117*); **79** (VI, 21; XI, 55); **93**, 207; **31** (3, LXXIX, 35); **66** (CCXXB). On *Gladiolus* and sometimes on other bulbs.
— '**glaucum** Link'. An undeterminable species frequently recorded, e.g. **55** (II, 721, 1827); **120**, 563; **8**, 299*; **28** (I, 184); **74** (VII, 59); **5**, 464, etc.
— **Godlewskii** Zaleski. **66** (CCXXB, 87). Isolated in Scotland.
— **guttulosum** Gilman & Abbott. *J. Oil Col. Chem. Ass.* XXII, 184, 1939. From rain-water, Sheffield.
— **hirsutum** Dierckx. Thom, p. 113; **22** (Bull. 117, 18). In hyacinth bulbs.
— **intricatum** Thom. **102** (X, 463, 1912). In soil, Woburn.
— **italicum** Wehmer. **5**, 463, 1910; **67** (CVB, 375); **104** (X, 184). In oranges.
— **Johannioli** Zaleski. **70** (XIX, 555, 1930). In butter, Ireland.
— **Kiliense** Weidemann. **66** (CCXXB, 90). From tobacco, Scotland.
— **lanosoviride** Thom in *The Penicillia*, p. 314, 1930; **66** (CCXXB). From water, Scotland.
— **lanosum** Westling. **88** (IV, 88, 1921; VI, 172). On leather. Thom, p. 317, refers to an isolation which, however, was not British, as implied; see **66** (CCXXB, 87).
— **lilacinum** Thom. **102** (XII, 43*, 1914); **34** (XV, 95); Thom, p. 334. In soil.
— **lividum** Westling. Thom, p. 205; **102** (XII, 52*, 1914); *J. Oil Col. Chem. Ass.* XXII, 184. In soil, etc.
— **luteum** Zukal. **28** (X, 111, 1924); **116**, 104; **66** (CCXXB, 255). In apples, etc.
— **macrosporum** Berk. & Br. in **19** (5, IX, 183, No. 1978, 1882); Sacc. IV, 82; **8**, 302. On *Lactarius*. Not recognised by Thom.
— **megalosporum** Berk. & Br. in **19** (4, XV, 34, No. 1457, 1875); Sacc. IV, 80. Described with spores up to 25 μ long. Massee **8**, 301 found no specimen.
— **meleagrinum** Biourge. *J. Oil Col. Chem. Ass.* XXII, 184; **66** (CCXXB). In rain-water, etc.
[— **Narcissi** A. Smith apud Brooks nomen nudum in **112**, 119, 1928; **22** (Bull. 117, 92); disease reported by A. Smith **31** (3, LXXIX, 35). On *Narcissus*.]
— **ovoideum** Preuss. **27** (L, 12*, 1912). On size. Thom considers Preuss's species undeterminable.

Penicillium oxalicum Currie & Thom. *J. Oil Col. Chem. Ass.* xxii, 184, 1939. From rain-water.
— **pallidum** G. Smith in **28** (xviii, 88*, 1933). From cotton yarn.
— **pruriosum** Salisbury. Reported **14** (xvi, 60); **8**, 300. An undeterminable species, teste Thom.
— **puberulum** Bainier. **28** (x, 111, 1924). From apples.
— **pulvillorum** Turfitt in **28** (xxiii, 186*, 1939). From soil, Middlesex.
— **pusillum** G. Smith in **28** (xxii, 255*, 1939). On dried peas, ?England.
— **quadrifidum** Salisbury. **14** (xvi, 60, 1887); **8**, 300. In human blood. An unknown species.
— **Raistrickii** G. Smith in **28** (xviii, 90*, 1933). From cotton yarn.
— **roqueforti** Thom. **28** (xxii, 174*); **116**, 106; Thom, p. 278. In cheese.
— **roqueforti** var. **viride** Dattilo-Rubo in **28** (xxii, 178, 1938). From Cheshire cheese.
— **rugulosum** Thom. **102** (xii, 40, 1914); **28** (x, 111); **116**, 107. In soil, etc.
— **Sartoryi** Thom. **70** (xix, 556). **74** (vii, 148*, 1912) as *Citromyces subtilis* Bain. & Sart. In beehives and butter.
— **silvaticum** Oudem. **28** (viii, 253, 1923). In a culture. Thom considers *P. silvaticum* to be undeterminable.
— **sparsum** Grev. ex Fr. in *Systema* iii, 407; Greville in **39**, t. 58, 1823; **51**, 467; **20**, 344; **15**, 602; **13**, 279; **8**, 320. As '*P. candidum* Link': *Mem. Wern. H.N. Soc.* iv, 71*, 1822. On old plants, etc. Probably not a *Penicillium*, teste Thom.
— **spinulosum** Thom. **70** (xix, 556, 1930; **66** (ccxxb, 83). In water, etc.
— **stoloniferum** Thom. **102** (xii, 52, 1914); **28** (x, 111; xviii, 88); **116**, 108. In soil, etc.
— **subtile** Berk. in **19** (i, vi, 437*, No. 241, 1841); Sacc. iv, 80; **15**, 603; **8**, 301. In a dead willow, Northants. Berkeley's figure suggests *Sporendonema Salicis* Bain.
— **subtile** var. **ramosius** Grove in **27** (xxiii, 165, 1885); Sacc. iv, 80; **8**, 301. On wood.
— **terrestre** Jensen. Thom, p. 372; **66** (ccxxb, 88). In milk, etc.
— **Thomii** Maire. *J. Oil Col. Chem. Ass.* xxii, 184, 1939. In rain-water, Wales.
— **varians** G. Smith in **28** (xviii, 89*, 1933). From cotton yarn.
— **viridicatum** Westling. **102** (xii, 56, 1914); **88** (vi, 175); **104** (vii, 239); **66** (ccxxb, 88). In soil, etc.

Periconia alternata (Berk.) Sacc. in *Syll.* iv, 275; **8**, 370; **35** (1911, 293); *Aspergillus* Berk. in **19** (i, i, 262*, No. 126, 1838). *Sporocybe* Berk. in **19** (i, vi, 434, No. 227, 1841); **15**, 567; **40** (vi, 121; vii, 271); Vize Exs. 243. On paper. The type specimen is a *Stachybotrys*. See synonymy by von Höhnel in *Centralbl. Bakt.* Abt. 2, lx, 14, 1923.
— **atra** Corda. **8**, 370*, 1893; **7**, 338. On grass, etc.
— **byssoides** Pers. ex Corda. **8**, 369; **7**, 338; **37** (1911, 377). As *Sporocybe*: **20**, 333, 1836; **15**, 566; **73** (1877, t. 27); **13**, 269; Cooke Exs. 278; Vize Exs. 240 and Fungi Brit. 172. On stems, etc.—See Linder **100** (xxix, 659) on *Periconia*.
— **circinata** (Mangin) Sacc. **28** (xxiii, 210, 1939). From wheat roots, Herts.
— **Desmazieri** (Fr.) Bon. **27** (l, 17*, 1912). On stems, Warwicks.—See von Höhnel (loc. cit.).
— **minima** (Cooke) Sacc. in *Syll.* iv, 275; **8**, 371. *Sporocybe* Cooke in **14** (v, 118, 1877); **73** (1877, t. 27). On millboard.
— **minutissima** Corda. **8**, 371, 1893. On *Alnus*.
— **nigrella** (Berk.) Sacc. in *Syll.* iv, 274; **8**, 370; **7**, 338; **37** (1909, 376). *Sporocybe* Berk. in **19** (i, vi, 433*, No. 226, 1841); **15**, 567*; **13**, 269. On grass, etc.
— **podospora** Corda. **8**, 370, 1893; **7**, 338; **35** (1907, 285). On Umbelliferae.
— **pycnospora** Fres. **27** (xxxv, 8, 1897: l, 17*); **35** (1908, 310). On herbs.

Phaeoisaria Cornui (Bainier) Mason in *Annotated Acc.* List ii, Fasc. 3, 94, 1937. Recorded **28** (xv, 10, 1930) as *Graphium fissum* Preuss. On elm near Bristol.

Polyscytalum fungorum Sacc. **14** (xvi, 58, 1887); **8**, 285*; **28** (xxi, 275). Conidial stage of *Hypomyces asterophorus* Tul.; see Plowright **14** (xi, 6*, 1884). It is one of the Endosporae: see Brefeld, *Untersuch.* x, 189 as *Pyxidiophora Nyctalidis* Bref. & von Tafel.

Polyscytalum sericeum Sacc. **27** (LXX, 46, 1932); **108** (IX, 52). On acorn-cups and leaves.

Ptychogaster albus Corda. **2**, 660; etc. Conidial stage of a polypore.

Rhinotrichum aureum Cooke & Massee in **14** (XVIII, 27, 1889); Sacc. X, 531; **8**, 308; **7**, 331. On old agarics.

— **Bloxami** Berk. & Br. in **19** (2, VII, 177*, No. 541, 1851); Sacc. IV, 93; **15**, 590; **8**, 307; **35** (1907, 103). On wood.

— **decipiens** Cooke in **14** (XIV, 6, 1885); Sacc. IV, 93; **8**, 307. On bark and moss.

— **decolorans** Cooke in **14** (V, 58, 1876); Sacc. IV, 92; **8**, 306; **35** (1912, 90). On chips, etc.

— **lanosum** Cooke in **15**, 591*, 1871; Sacc. IV, 92; **19**, No. 1316; **8**, 307; **7**, 331; **37** (1911, 377); Vize Exs. 77, and 579. Cooke issued Exs. 356 as *Clinotrichum lanosum*, nomen nudum; he gave a description of '*Clinotrichum* gen.nov.' in **59** (1871, p. 10* of reprint), stating at the same time that it was a *Rhinotrichum*. On wall-paper.

— **niveum** Cooke & Massee in **14** (XVI, 10, 1887); Sacc. X, 532; **8**, 306*; **7**, 331; **28** (XVI, 5). On wood.

— **Opuntia** Berk. & Br. in **19** (2, XIII, 462*, No. 761, 1854); Sacc. IV, 91; **15**, 590; **8**, 306. On wood, Woolwich.

— **ramosissimum** Berk. & Curt. in **14** (XI, 14, 1882); Sacc. IV, 95; **8**, 308; **28** (I, 164); **35** (1912, 90). On wood.

— **repens** Preuss. **19** (3, XVIII, 121, No. 1149, 1866); **15**, 591; **13**, 275; **48** (V, 234); **8**, 306; **7**, 331; Cooke Exs. 546. On wood.

— **Thwaitesii** Berk. & Br. in **19** (2, VII, 177*, No. 542, 1851); Sacc. IV, 95; **15**, 590; **8**, 308; **28** (II, 57); **71** (XLII, 53). On soil and leaves. Melin & Nannfeldt, *Svenska Skogsvardsf. Tidsk.* 1934, p. 457, found it belonged to *Hyphelia*.

— **Thwaitesii** var. **fulvum** Grove in **27** (XXIII, 166, 1885); Sacc. IV, 95; **8**, 308. On wood, Warwicks.

Rhopalomyces candidus Berk. & Br. in **19** (2, VII, 96*, No. 505, 1851); Sacc. IV, 50; **15**, 618*; **8**, 290; **7**, 329; **71** (XXVIII, 148). On old hops, etc.—Thaxter, *Bot. Gaz.* XVI, 14, considered *R. pallidus* (q.v.) the same, and an *Oedocephalum*.

— **elegans** Corda. **8**, 291, 1893; **33** (XVI, 82). On stems and on dung.

— **pallidus** Berk. & Br. in **19** (2, VII, 96*, No. 504, 1851); Sacc. IV, 50; **15**, 618; **46** (II, 348); **8**, 291*; **71** (XXVIII, 148); *Oedocephalum* Cost. in **117** (XXIII, 492, 1886). On matting.

Scopulariopsis brevicaulis (Sacc.) Bainier. Reported **28** (XIX, 146, 1935) as *S.* '*brevicaule* Link'. In air.

— **communis** Bainier. **27** (XLVI, 154, 1908); **102** (XII, 46); Thom, *The Penicillia*, p. 527. In soil and on stems.

— **Costantini** (Bainier) Dale in **102** (XII, 57, 1914); Thom, p. 528. In soil.

— **penicillioides** (Delacr.) A. L. Smith & Ramsb. in **28** (V, 164, 1915). As *Monilia*: **28** (XVII, 174); **35** (1932, 167). On pupae, etc. See *S. rufulus*.

— **repens** Bainier. **102** (XII, 46, 1914); **116**, 109. In soil.

— **rufulus** Bainier. **102** (XII, 45, 1914, reported in error in Vol. X as *Monilia Koningi*); Thom, p. 538. In soil. Miss Dale's culture is referred to *S. penicillioides*, **28** (V, 164).

Sepedonium chrysospermum Fr. **20**, 350; **15**, 619*; **8**, 325*; **13**, 286; **102** (XII, 48); Ramsbottom, *Handbook Larger British Fungi*, p. 194; Vize Exs. 252. As *Mucor*: **42**, t. 398; **55** (III, 502). *M. argenteus* With. in **38** (Ed. 2, III, 483, 1792). As *Sependonium mycophilum* Nees: **39**, t. 198; **51**, 486; **58** (II, 209) On Hymenomycetes, chiefly species of *Boletus*; a stage of *Apionectria chrysosperma* (Tul.) Syd.; see **28** (XXI, 275) and **14** (XI, 4*). See *Sporotrichum chrysospermum*.

— **mucorinum** Harz var. **botryoides** Bayliss Elliott in **28** (IV, 294, 1914); Sacc. XXV, 704. On soil.

— **niveum** Massee & Salm. in **33** (XVI, 80*, 1902); Sacc. XVIII, 532). On dung of deer, Kew.

— **sepedonioides** (Harz) A. L. Smith in **33** (XXXVI, 181*, 1898). On cardboard, Mon.

Sepedonium Tulasneanum Sacc. in *Syll.* IV, 148, named from description and figure **14** (XI, 46*, 1882); **8**, 325; **28** (XXI, 276). On *Boletus*, a stage of *Apiocrea Tulasneana* (Plowr.) Petch.
— **xylogenum** Sacc. **68** (1901, 615*); **28** (I, 184*). On a grass seed.
Sigmoideomyces clathroides Bayliss Elliott in **28** (IV, 121*, 1909); Sacc. XXV, 653. On soil, Birmingham.
— **divaricatus** McLean in **28** (VIII, 246*, 1923). On soil, Wales.
Spicaria elegans (Corda) Harz. **8**, 332*, 1893; **35** (1911, 393; 1912, 90). On bark, etc. Thom, *The Penicillia*, considered it a *Paecilomyces*.
— **elegans** var. **muscorum** Grove ex Sacc. in *Syll.* IV, 166, based on Grove **27** (XXIII, 165*, 1885 as *S. elegans*); **8**, 332. On moss and wood, Sutton.
— **griseola** Sacc. **34** (XVII, 295*, 1930). In soil, Wales.
— **simplex** Petch in **35** (1936, 60). On *Trichia*, Yorks.
— '**Solani** Reinke & Berth.' teste Wollenw. & Reink. As *Fusarium minutulum* Corda: **19** (4, XV, 34, No. 1457, 1875); **8**, 485. On chips, etc.
— **Swantonii** (A. L. Smith) Petch in **35** (1931, 103); **28** (XVII, 175). *Coremium* A. L. Smith in **28** (VI, 156*, 1919); Sacc. XXV, 927; **35** (1932, 133). On insects.
Sporotrichum aurantiacum Fr. *S. aurantiacum* Grev. in *Mem. Wern. Nat. Hist. Soc.* I, 70*, 1822 is perhaps the same; see **20**, 347; Sacc. IV, 104; **15**, 610; **13**, 284; **28** (III, 237); **8**, 310; **38** (Ed. 3, IV, 402, 1796) as *Mucor aurantius* Bull.; **120**, 551 as *Spototrichum aureum* Link. On dung, etc. Various kinds of Amerosporae have been referred to *Sporotrichum*.
— **carnis** Brooks & Hansford in **28** (VIII, 131*, 1923); **28** (IX, 174); **70** (XIX, 564); **66** (CCXXB, 99). On meat, etc. This fungus might be referred to Traaen's genus *Geomyces*.
— **chlorinum** Link ex Fr. **20**, 346, 1836; **15**, 610; **13**, 283; **8**, 311; **7**, 332. On oak leaves, etc.
— **chrysospermum** Harz. **27** (L, 12*, 1912); **28** (VI, 247 and 370). On wood. Some of the records of *Sepedonium chrysospermum*, with which this *Sporotrichum* was at first confused, may belong here.
— **cinnamomeum** Wallr. **108** (IX, 52, 1934). On dry *Phoenix*, Evesham.
— **flavissimum** Link ex Fr. **14** (XVI, 61, 1887); **8**, 309; **71** (XXVIII, 148); **28** (IV, 20). On wood, etc.
— **geochroum** Desm. ex Fr. **20**, 346, 1836; **15**, 611; **14** (XIII, 51); **8**, 310*; **70** (1936, 410). On wood.
— **Isariae** Petch in **35** (1931, 102); **28** (XVII, 178; XVIII, 69). On *Isaria farinosa*. See *I. leprosa*.
— **laeticolor** Cooke & Massee in **14** (XX, 38, 1891); Sacc. X, 532; **7**, 331. On bark, Yorks.
— **lanatum** Wallr. **28** (III, 223, 1910); **35** (1910, 405; 1911, 166; 1915, 48). In polluted water, etc.
— **laxum** Nees ex Fr. **20**, 347; **15**, 610; **13**, 284; **8**, 309; **68** (1901, 615); **28** (I, 184); **71** (XXVIII, 148); **34** (XVII, 289). *S. minutum* Grev. in *Mem. Wern. Nat. Hist. Soc.* I, 68*, 1822; **39**, t. 108; **51**, 464. **120**, 551, 1821 as *S. candidum* Link. On wood, etc.
[— **macrosporum** Grev. in **51**, 464 was evidently a powdery mildew.]
— **Malorum** Kidd & Beaumont in **28** (X, 111, 1924). In apples. This is evidently not a *Sporotrichum*, but one of the Gloiosporae; see **99** (XIX, 443).
— **maritimum** Sutherland in **32** (XV, 43*, 1916); Sacc. XXV, 690. On *Laminaria*, Dorset.
— **merdarium** Link ex Fr. **27** (XXIV, 199, 1886); **8**, 310. On dog's dung, Hereford.
— **olivaceum** Fr. *Virgaria olivacea* (Link) Gray in **120**, 553, 1821. On felled trees.
— **roseum** Link ex Fr. **35** (1913, 175); **67** (CXVIIB, 154); **102** (XII, 53*); **28** (XIX, 146). On paper, etc.
— **sulphureum** Grev. ex Fr. in *Systema*, III, 423; Grev. in **39**, t. 108, 1824; **51**, 465; **20**, 347; **15**, 610*; **13**, 284; **8**, 310; Berk. Exs. 211; Cooke Exs. II,

No. 537; Vize Exs. 343. On bark, etc.—Harz thought it might be the same as *S. flavissimum*.

[**Sporotrichum tenuissimum** Grev. in *Mem. Wern. Nat. Hist. Soc.* I, 69*, 1822 and **51**, 465 was probably only mycelium, teste Berkeley **20**, 347.]

— **terricola** Grove in **27** (L, 13*, 1912); Sacc. xxv, 692. On soil, Worcs.

Stemmaria aeruginosa Massee in **37** (1913, 199*); Sacc. xxv, 933. On dung, Kew.

Streptothrix fusca Corda. **27** (LXX, 36*, 1932). On stems of *Rubus*, Wales.

Strumella strobilina Cooke & Massee in **14** (XVIII, 20, 1889); Sacc. x, 733.—On cones, Newcastle.

Stysanus Clematidis Fuckel. **14** (XVII, 11, 1888); **8**, 459. On *Clematis*.

— **cybosporus** D. Sacc. **27** (L, 46, 1912); **28** (VI, 87). On stems.

— **fimetarius** (Karst.) Massee & Salm. in **33** (XVI, 86*, 1902); **28** (II, 34). On dung, etc.

— **Mandlii** Mont. **27** (L, 46, 1912). On twigs, Warwicks.

— **medius** Sacc. **34** (XVII, 295, 1930). In soil, Wales.

— **microsporus** Sacc. **28** (IV, 328, 1914; VI, 53); **70** (XIX, 564). On bark, etc.

— **putredinis** Corda. **19** (5, I, 27, No. 1712, 1878); **13**, 281; **48** (II, 259); **8**, 459. On leaves, etc.

— **Stemonitis** (Pers. ex Fr.) Corda. **15**, 605*, 1871; **13**, 281; **8**, 458*; **68** (1901, 615); **28** (I, 184; XIX, 147); **7**, 346; **66** (CXCVIIB, 7); **33** (XVI, 86); **63** (LXVIII, 226); **5**, 467; **116**, 154; **77** (1931, 149). On leaves, etc. 'Var. *ramosa* Pim': **71** (2, IV, 27); **28** (I, 65). See *Echinobotryum*.

— **Ulmariae** McWeeney in **48** (IV, 277*, 1895). On dying *Spiraea*, Ireland.

Symphyosira parasitica Massee & Crossland in **35** (1904, 6); Sacc. XVIII, 647; **7**, 345. On fruits of *Conium* and *Heracleum*, Yorks.

Torula abbreviata Corda. **14** (XVI, 97, 1888); **8**, 360; **28** (VI, 54). On wood, etc.

— **abbreviata** var. **sphaeriiformis** Berk. & Br. in **19** (2, V, 461, No. 464, 1850); Sacc. IV, 256; **15**, 477; **8**, 360. On herbs and pine branches.

— **Allii** Harz. **34** (XVII, 296*, 1930). In soil, Wales.

— **antennata** Pers. ex Fr. **8**, 361; **7**, 337; **28** (XXII, 4; XXIV, 3). *Monilia antenniformis* (Hoffm.) Gray in **120**, 557, 1821. On wood. See *Bispora monilioides*.

— **asperula** Sacc. **8**, 363, 1893; **48** (XX, 181); **115**, 99. On paper, etc.

— **botryoides** Brooks & Hansford [non Corda] in **28** (VIII, 134*, 1923). On meat.

— **cylindrica** Berk. in **20**, 359, 1836; Sacc. IV, 254; **15**, 477; **13**, 229; **8**, 360. On sticks, Scotland.

— **epizoa** Corda ex Kickx? **28** (V, 243, 1916); **115**, 99. On grease. See *Rev. Appl. Mycol.* XIX, 402.

— **expansa** Fr. **14** (XVI, 97, 1888); **8**, 361; **35** (1908, 285; 1909, 221); **71** (XXVIII, 149). On herbs, etc.

— **fusca** (Bon.) Sacc. **28** (VI, 373). *Oospora fusca* (Bon.) Grove in **27** (XXIII, 163*, 1885); **8**, 280. On *Bulgaria*, etc.

— **graminis** Desm. **19** (1, I, 263, No. 134, 1838); **15**, 478; **40** (VII, 32); **8**, 362; **7**, 337; Cooke Exs. II, No. 629; Vize Exs. 22. On grasses and sedges.

— **gyrosa** Cooke & Massee in **14** (XVI, 10, 1887); Sacc. x, 573; **8**, 360. On pine wood, Kew.

— **herbarum** Link ex Fr. **120**, 557, 1821; **51**, 469; **58** (II, 210); **15**, 478*; **13**, 229; **8**, 362; **7**, 337; **66** (CXCVIIB, 7); Vize Exs. 23 and Fungi Brit. 107; Cooke Exs. 362 and II, No. 630. On stems, etc.

[— **lichenicola** Lindsay was transferred by Petrak & Sydow to *Vouauxiella*; see **119**, 566 and Grove **1** (II, 133) as *Sirothecium*. It is apparently a Coelomycete.]

— **lucifuga** Oudem. **34** (XVII, 298*, 1930). In soil, Wales.

— **monilioides** Corda ex Berk. in **20**, 359, 1836; **15**, 476; **8**, 360*; **37** (1897, 423); **7**, 336. On wood.

— **nucleata** Cooke in **14** (XVI, 79, 1888); Sacc. x, 574; **8**, 362. On herbs.

— **ovalispora** Berk. in **20**, 359, 1836; **15**, 476; **13**, 228; **14** (XVII, 21); **8**, 361; **71** (XXVIII, 149). *Oospora* Sacc. & Vogl. in *Syll.* IV, 13; **7**, 337. On wood.

[**Torula parasitica** Pim. **71** (XXVIII, 149). We have not seen the description of this doubtful, forgotten species.]

— **pulveracea** Corda. **15**, 476, 1871; **13**, 228; **8**, 361; **46** (II, 214); **7**, 336; Cooke Exs. 347 and II, No. 334; Vize Exs. 117. On wood.

— **pulvillus** Berk. & Br. in **19** (2, V, 460, No. 463, 1850); Sacc. IV, 252; **15**, 476; **8**, 359; **71** (XXVIII, 149). On oak bark.

— **rhizophila** Corda. **14** (XVI, 97, 1888); **8**, 362. On rhizomes of grasses and sedges.

— **spongicola** Dufour. **28** (III, 36, 1908). On a sponge, London.

— **Tuberculariae** Nees ex Fr. **28** (XXIV, 56, 1940). On *Tubercularia*, Kew.

— **ulmicola** Rabenh. **14** (III, 124, 1875); **13**, 229; **8**, 359. On elm bark.

Trichosporium calcigena (Link ex Fr.) Sacc. **27** (LIV, 221, 1916). On walls, Birmingham.

— **chartaceum** (Pers. ex Fr.) Sacc. **27** (L, 44, 1912); **35** (1913, 175). On paper.

— **fuscum** (Link ex Wallr.) Sacc. **8**, 367*; **7**, 337; **120**, 551, 1821 as *Sporotrichum*; *Macrotrichum ferrugineum* Grev. in **51**, 64, 1824. On bark; a stage of *Rosellinia aquila*.

— **inosculans** (Berk.) Sacc. in *Syll.* IV, 293; **8**, 367; **7**, 337. *Sporotrichum* Berk. in **20**, 346, 1836; **15**, 610; **13**, 284. On *Thelephora* and other fungi.

— **insigne** Massee & Salmon in **33** (XVI, 85*, 1902); Sacc. XVIII, 574. On pigeon's dung, Kew.

— **murinum** (Link ex Fr.) Sacc. **27** (XXIV, 201, 1886); **8**, 367; **7**, 337; **34** (XVII, 296*). On wood, etc.

— **splenicum** Sacc. & Berl. **28** (I, 114, 1900). On wood, Wales.

— **Tulasnei** Lindau. As *T. umbrinum* (Pers.) Lindau: **14** (XVII, 3, 1888); **8**, 366. 'Running over plant pots.' See *Isaria umbrina*, upon which *Trichosporium umbrinum* was originally based.

Tuberculina persicina (Ditm. ex Fr.) Sacc. **10**, 299; **9**, 204*; **8**, 467*; **71** (XXVIII, 150). As *Tubercularia*: **18**, 341, 1860; **15**, 558. On Uredinales.

— **Sbrozzii** Cav. & Sacc. Common on *Puccinia Vincae*, but apparently recorded in Britain only by Grove **3**, 177, 1913, as a possible uredo stage of the rust.

— **vinosa** Sacc. **9**, 204; **8**, 467; **71** (XXVIII, 150). As *Tubercularia*: **14** (XIII, 52, 1884). On Uredinales.

Urophiala parasitica (Grove) A. L. Smith in **28** (VI, 296, 1920). *Pimina* Grove gen.nov. in **27** (XXVI, 206, 1888); **48** (II, 259); **28** (I, 65*). On *Botrytis*, on *Passiflora*. See E. W. Mason, *Annotated Acc.* List II, Fasc. 3, 1941.

Verticicladium apicale (Berk. & Br.) Sacc. in *Syll.* IV, 328; **8**, 386*. *Verticillium* B. & Br. in **19** (2, VII, 101*, No. 531, 1851); **15**, 598. On oak, Somerset.

— **Cheesmanii** Crossland in **35** (1907, 98*); Sacc. XXII, 1361. On wood, Yorks.

— **trifidum** Preuss. **14** (VI, 23, 1877); **8**, 386. On pine leaves, Shrewsbury.

Virgaria nigra Nees ex Sacc. **15**, 611*; **13**, 284; **8**, 374; **39**, t. 274, 1823 as *Botrytis*; **20**, 346 as *Sporotrichum*. On wood. The citation *V.* '*umbrina* Kl.' **14** (XVI, 98) and **8**, 358* may refer to the same fungus.

Wardomyces anomala Brooks & Hansford gen.nov. in **28** (VIII, 137*, 1923). On meat.

Zygodesmus fulvus Sacc. **27** (L, 7*, 1912; LV, 136). On wood.

— **fulvus** var. **olivascens** Sacc. **35** (1907, 99). Yorks.

— **fuscus** Corda. **68A** (V, 127*, 1857); **15**, 611*; **13**, 284; **8**, 376; **48** (VII, 288); **66** (CXCVIIB, 7); **7**, 338; Vize Exs. 577. On wood.

— **marginatus** Cooke & Harkn. Recorded with doubt, **40** (IX, 172, 1887). On wood, Scotland.

— **terrestris** Berk. & Br. in **19** (5, VII, 130, No. 1915, 1881); Sacc. IV, 284; **8**, 376*. On chalk, Kent. Massee's figure shows clamp-connexions, and the fungus is probably a *Tomentella*.

Zygosporium oscheoides Mont. **89**, 168*. *Cladotrichum Passiflorae* Pim in **31** (XXIV, 724*, 1885), teste Cooke. On *Passiflora*.

XEROSPORAE—DIDYMOSPORAE

Antromyces Copridis Fres. **28** (VI, 64, 1918). In dung-case of *Copris* beetle.

Arthrobotrys oligospora Fres. **27** (XXII, 198*, 1884; L, 14); **33** (XVI, 83). On dung, etc.—See **100** (XXIX, 447) for *Arthrobotrys*.

— **rosea** Massee in **68** (2, V, 758*, 1885); Sacc. IV, 182; **8**, 338*; **7**, 335; **71** (XXVIII, 149). On branches. Matruchot, *Recherches Dévelop. Mucéd.*, 1892, thought it might be the same as *A. oligospora*; see also **100** (XXIX, 469).

— **superba** Corda. **33** (XVI, 83*, 1902); **7**, 335; **28** (III, 289; VII, 10). On dung, etc.

Bispora monilioides Corda. **18**, 327, 1860; **15**, 481*; **13**, 230; **8**, 390*; **7**, 339; **66** (CXCVII B, 7); **71** (XLII, 54); Cooke Exs. 346 and II, No. 333. In error as '*Torula antennata*': **39**, t. 255, 1827; **20**, 359; Berk. Exs. 215; see **18**, 327. On wood, especially on the cut ends of oak and beech logs.

— **pusilla** Sacc. **27** (XXII, 199, 1884); **14** (XVII, 80); **37** (1909, 376). On wood, etc.

Bostrichonema alpestre Ces. **8**, 340*; **7**, 335. *Dactylium spirale* Berk. & White in **40** (IV, 162*, 1877); **19** (5, I, 28*, No. 1717). On leaves of *Polygonum*.

— **modestum** (Berk. & White) Sacc. in *Syll.* IV, 185; **8**, 341. *Dactylium* Berk. & White in **40** (IV, 162*, 1877); **19**, No. 1718*. On *Alchemilla*, Scotland.

Chlamydomyces Palmarum (Cooke) Mason in *Annotated Acc.* List II, Fasc. 1, 37, 1928. One British collection on old elm leaves.

Cladosporium Algarum Cooke & Massee in **14** (XVI, 80, 1888); **8**, 396; **32** (XV, 37*). Transferred to *Heterosporium* by Cooke & Massee in **14** (XVIII, 74, 1890); Sacc. X, 660. On *Laminaria*.—Several of the so-called species of *Cladosporium* included here are probably *C. herbarum*; see **28** (VIII, 113).

— **Aphidis** Thüm. **28** (VI, 203, 1919; VIII, 123; XVII, 175); **27** (LX, 175); **35** (1932, 168). On aphids; evidently *C. herbarum*.

— **brachormium** Berk. & Br. in **19** (2, VII, 99, No. 515, 1851); Sacc. IV, 363; **15**, 584; **8**, 394; **7**, 430. On *Fumaria*.

— **carpophilum** Thum. **35** (1920, 403); **31** (3, LXXXIX, 151); **85** (XXV, 142); **77** (1928, 118); **79** (V, 30; XI, 52); **65** (XXX, 339); **71** (XLII, 54); **93**. On *Prunus domestica*. *C. carpophilum* and *Fusicladium Cerasi* are often considered synonymous, but see **99** (XVIII, 313).

— **compactum** Berk. & Curt. **71** (XXVIII, 149, 1910). Ireland.

— **cucumerinum** Ellis & Arthur. **22** (Misc. Publ. 33, p. 44); **34** (VIII, 13); **80**; **112**, 337. *C. scabies* Cooke in **56** (1904, p. clxix and clxxi); **89**, 102; **5**, 475; **23** (XVIII, 820). On cucumbers.

— **delectum** Cooke & Ellis. A form recorded **108** (IX, 52, 1934). On *Magnolia*, Worcs.

— **epibryum** Cooke & Massee. **8**, 396, 1893. On mosses.

— **epiphyllum** Nees ex Fr. **15**, 583; **8**, 393; **5**, 471*; **5B**, 306; **66** (CXCVII B, 7); **23** (XIV, 622; XVII, 301); **37** (1899, 1; 1914, 190); **102** (X, 468*); **89**, 125*; Cooke Exs. 188; Vize Fungi Brit. 179. On leaves, etc., doubtless *C. herbarum*; see **28** (VIII, 123).

— **fasciculare** Fr. **15**, 583; **8**, 395; **35** (1914, 252); **71** (XXVIII, 149); Vize Exs. 238. On Monocotyledons.

— **fasciculatum** Corda. **70** (1936, 416). On *Sparganium* and *Scirpus*, Ireland.

— **fulvum** Cooke in **14** (XII, 32, 1883, described from America); **31** (3, II, 532*, 1887, with suggestion of 'var. *violaceum*'); **8**, 393; **56** (XIX, 14; XXVI, 725*; XXVII, 817*; XXVIII, 142); **23** (V, 192; XVIII, 920, etc.); **66** (CXCVII B, 7); **5B**, 311; **5**, 470; **112**, 338*; **34** (VIII, 13; XVII, 71; XVIII, 305; XIX, 155; XXIII, 183); **82** (XII, 34); **79** (I–XI); **65** (XXX, 342); **104** (VII, 245); **85** (XXVII, 88; XXXVIII, 18); **25** (XXXIII, 217). On *Lycopersicum*.

— **graminum** Corda. **70** (1936, 416); **28** (XXII, 11). On *Phalaris*, *Poa*, and *Carex*, Ireland.

— **herbarum** Link ex Fr. Very many records, including **120**, 556; **15**, 582*; **8**, 394; **28** (VIII, 113; X, 112); **57** (V, 36); **33** (XXIV, 359*); **75** (XII, 489); **34**

(xv, 191); **116**, 93; *Poultry Sci.* vi, 251; Cooke Exs. 352 and ii, No. 163; *Dematium articulatum* Sow. in **42**, t. 400, 1803. **74** (vi, 44*) as *Hormodendron cladosporioides* (Fres.) Sacc.; **27** (L, 18). On many substances.

Cladosporium juglandinum Cooke in **14** (xvi, 80, 1888); Sacc. x, 604; **8**, 394. On fading walnut leaves, Highgate.

— **Kniphofiae** Cooke in **14** (xiv, 40, 1885); Sacc. iv, 367; **8**, 395. On dead leaves of *Kniphofia*, Kew.

— **lignicola** Corda. **19** (2, vii, 100, No. 516, 1851); **15**, 584; **8**, 393; **7**, 340; Vize Exs. 349. On wood.

— **Lycopersici** Plowr. in **31** (xvi, 621*, 1881); **31** (3, ii, 409*); **23** (iii, 154; v, 192). On tomato fruits; probably *C. herbarum.* See *Alternaria Tomato.*

— **myrmecophilum** (Fres.) Bayliss Elliott in **28** (v, 138*, 1915); Sacc. xxv, 798. In ants' nests, Britain.

— **nodulosum** Corda. **19** (2, vii, 100, No. 517, 1851); **15**, 585; **8**, 394; **71** (xxviii, 149). On stems.

— **orchidearum** Cooke & Massee in **14** (xvi, 80, 1888); Sacc. x, 605; **31** (Oct. 1890*); **8**, 395; **5**, 475; **89**, 172*. On orchids, Kew.

— **Paeoniae** Pass. Vize Exs. 242; **56** (xxvii, 19*, 1902). On *Paeonia.*

— **Pisi** Cug. & Macch. **22** (Misc. Publ. 38, p. 42, 1922). On *Pisum*, Shropshire.

— **punctulatum** Sacc. & Ellis. **70** (1936, 416). On old *Euonymus*, Ireland.

[— **sphaeroideum** Cooke. Saccardo, *Syll.* iv, 365, erroneously cited this as British, so Massee **8**, 395 included it.]

— **sphaerospermum** Penz. Recorded for Britain in *Syll.* iv, 355, and therefore **8**, 393. On *Citrus.*

— **Typharum** Desm. Vize Exs. 573; **28** (vi, 374, 1920). On *Typha.*

Cladotrichum fuscum (Fr.) Sacc. **8**, 398. Fries, *Systema*, iii, 426, described *Trichothecium fuscum* and cited as synonym '*Macrotrichum heterosporium* Grev. Ed. Phil. Journ. iii, t. 1'. Berkeley **20**, 348 could not find this Greville reference. On dead capsules of *Gentiana.*—*Cladotrichum fuscum* Preuss has priority in this genus, but Saccardo renamed it *C. Preussii.*

— **triseptatum** Berk. & Br. in **19** (2, vii, 98*, No. 511, 1851); Sacc. iv, 371; **15**, 581*; **8**, 398. On wood, Northants.

— **uniseptatum** Cooke in **14** (iii, 182*, 1875); **73** (1877, t. 25). *C. Cookei* Sacc. in *Syll.* iv, 370; **8**, 398*; **35** (1908, 411). On wood. Saccardo changed Cooke's name [which has priority in *Cladotrichum*] in order to transfer *Virgaria uniseptata* to the genus. See *Scolecotrichum uniseptatum.*

Dicoccum uniseptatum (Berk. & Br.) Sacc. in *Syll.* iv, 342; **8**, 389*. *Sporidesmium* B. & Br. in **19** (3, iii, 360*, No. 815, 1859); **15**, 485. On *Clematis*, Batheaston.

Didymaria didyma (Unger) Schroet. **28** (iii, 59); **70** (1936, 412). As *Ramularia*: **14** (xii, 36, 1883); **40** (viii, 228; x, 67); **8**, 340* as *Didymaria Ungeri* Corda. On *Ranunculus.*

— **Kriegeriana** Bres. **108** (ix, 52, 1934); **28** (xxiii, 238). On *Lychnis.*

Didymocladium ternatum (Bon.) Sacc. **28** (i, 114, 1899; ii, 137); **27** (L, 15). On *Stereum.*

Diplocladium macrosporum (Fr.) Massee in **8**, 335; **7**, 334; **71** (xxviii, 149). As *Dactylium*: **20**, 345, 1836; **15**, 607; **13**, 282; **68A** (1877, 191). On moss, etc.

— **melleum** (Berk. & Br.) Sacc. in *Syll.* iv, 177; **8**, 335*; *Dactylium* B. & Br. in **19** (4, xi, 345*, No. 1382, 1873). On old *Polyporus* and *Stereum*, Batheaston.

— **minus** Bon. **8**, 334, with synonym *D. Renneyi* (B. & Br.) Sacc. in *Syll.* iv, 177. *Dactylium Renneyi* B. & Br. in **19** (4, xi, 346, No. 1383, 1873); **14** (ii, 138). On a stump, Hereford.

— **penicillioides** Sacc. in *Syll.* iv, 177, based on Plowright **14** (xi, 44*, 1882) as the unnamed conidial state of *Hypomyces aurantius*; **8**, 334; **28** (xxi, 274). On *Polyporus* and other fungi.

— **tenellum** (Fr.) Massee in **8**, 335, 1893; **28** (iv, 20). As *Dactylium*: **19** (2, vii, 102, No. 536, 1851); **15**, 607; **13**, 281. On moss, Dundee.

Diplococcium resinae (Corda) Sacc. **34** (XVII, 291, 1930). In soil. Perhaps Cooke Exs. II, No. 643, as '*Sporotrichum resinae*' on resinous fir.

— **spicatum** Grove gen.nov. in **27** (XXIII, 167*, 1885); Sacc. IV, 374; **8**, 399; **27** (L, 44, with correction of diagnosis). On wood.

Diploospora rosea Grove gen.nov. in **27** (LIV, 220*, 1916); Sacc. XXV, 713. On paper, Scarborough.

Diplosporium album Bon. **8**, 336*, 1893; **7**, 334. On stems.

— **album** var. **fungicola** Sacc. in *Syll.* IV, 178, based on Plowright **14** (XI, 49*, 1882) as conidia of *Hypomyces violaceus*; **8**, 336. On *Fuligo*.

— **cervinum** (Berk. & Br.) Sacc. in *Syll.* IV, 178; **8**, 336. *Dactylium* B. & Br. in **19** (5, I, 28, No. 1716, 1878); **13**, 283. On laburnum.

Endodesmia glauca Berk. & Br. gen.nov. in **19** (4, VII, 432*, No. 1318, 1871); Sacc. IV, 691; **8**, 476*. On cabbage stalks, Batheaston.

Epochnium monilioides Link ex Fr. **120**, 550, 1821. 'On dried plants and pears.'

Fusicladium Cerasi (Rabenh.) Sacc. **5**, 469, 1910; **78** (1928, 189); **112**, 336; **85** (XXIX, 17). On *Prunus Cerasus*. See *Cladosporium carpophilum*.

— **dendriticum** (Wallr.) Fuckel. Very many reports, lately as *Venturia inaequalis*; see **28** (XXIV, 172); **89**, 113; **77**; **104**; **56**; **23**, etc. Other early records as *Cladosporium* and as *Spilocaea pomi* Fr. On *Pyrus Malus*.

— **depressum** (Berk. & Br.) Sacc. in Fungi Ital. t. 783; **8**, 391*; **7**, 340; **70** (1936, 416). *Cladosporium* B. & Br. in **19** (2, VII, 99*, No. 514, 1851); **15**, 584; **13**, 273. On *Angelica*.

— **pirinum** (Lib.) Fuckel. **14** (VIII, 111, 1880); **68** (1900, 424*); **23** (XI, 684); **89**, 123*; **104** (XI); **77**. As *Cladosporium* sp.: **31** (1848, 398); then for some time pear scab was attributed to *C. dendriticum*, e.g. **15**, 583. For recent reports as *Venturia* see **28** (XXIV, 172). On *Pyrus communis*.

— **pirinum** var. **Pyracanthae** Thüm. **28** (XXII, 219). As *Cladosporium* sp.: **31** (1848, 716). As *C. orbiculatum* Desm.: **19**, No. 513, 1851. As a variety of *C. dendriticum*: **18**, 346; **15**, 583. As '*Actinonema Crataegi*': **31** (1855, 725). As *Fusicladium Crataegi* Aderh.: **85** (XXXIX, 18). As *F. Pyracanthae*: **79** (XIII, 30). On *Crataegus Pyracantha*.

— **saliciperdum** (Allescher & Tubeuf) Tubeuf. **64** (XXXVIII, 128, 1924; XXXIX, 34); **28** (XI, 163*; XVI, 76); **65** (XXX, 349); **78** (1927, 209); **85** (XXVII, 87); **32** (XXXIV, 64); **93**, 225. On *Salix*.

Gymnodochium fimicola Massee & Salm. gen.nov. in **33** (XVI, 89*, 1902); Sacc. XVIII, 668. On dung of wild sheep, Kew.

Mycogone alba Letell. **14** (XVII, 80, 1889); **31** (1893, 299); **89**, 108*. On mushrooms. See **28** (XXIV, 197) for *Mycogone* stages with *Hypomyces* names.

[— **anceps** Sacc. **8**, 339. 'Chlamydospores' of *Pilobus*.]

— **cervina** Ditm. ex Chev. **91**, 304, 1857; **14** (VIII, 104; XI, 51*; XVI, 64); **8**, 339*. On Pezizales.

— **perniciosa** Magnus. **28** (X, 83*, 1924); **31** (3, LXXXVII, 516*); Ramsbottom, *Handbook Larger British Fungi*, p. 73; **112**, 332; **85** (1932–8); **79** (XII, 32); **93**, 252. On *Agaricus*. The fungus produces a *Diplocladium* stage, apparently not named.

— **rosea** Link ex Chev. **8**, 339; **31** (3, CV, 236); **71** (XXVIII, 149). As *Sepedonium*: **20**, 351, 1836; **19** (1, I, 263, No. 132); **15**, 620; **13**, 286; **14** (V, 9; XI, 50*). On *Agaricus*, etc.

Passalora bacilligera Mont. & Fr. **8**, 390; **89**, 216*; **71** (XXVIII, 149). As *Cladosporium*: **15**, 584, 1871; Cooke Exs. 290. On fading leaves of *Alnus*. See *Centralbl. Bakt.* 2 Abt. LX, 2.

Polythrincium Trifolii Kunze ex Fr. **39**, t. 216; **20**, 338; **15**, 582*; **13**, 272; **8**, 392; **89**, 247*; **28** (IX, 218*, life history); **70** (1936, 416); Baxter Exs. 84; Berk. Exs. 97; Cooke Exs. 196 and II, No. 158; *Farinaria* Sow. in **42**, t. 396, 1803. On *Trifolium*; stage of *Dothidella* (or *Cymadothea* in **100** (XXVII, 71)).

Rhynchosporium Secalis (Oudem.) J. J. Davis. **32** (XXVII, 215*, 1928); **112**, 333*; **23** (XXXV, 1095); **79** (V, 24; XI, 44); **1** (II, 281); **27** (LX, 168) as

Marssonia; **22** (Misc. Publ. 33, p. 31) as *R. graminicola* Heinsen. On *Secale, Hordeum, Bromus, Dactylis.*

Scolecotrichum Clavariarum (Desm.) Sacc. **8**, 392; **5**, 469; **28** (XVI, 15). As *Helminthosporium*: **19** (1, I, 260, No. 123, 1838); **15**, 573. On *Clavaria*; reputed stage of *Helminthosphaeria*. See *Centralbl. Bakt.* Abt. 2, LX, 6 on *Scolicotrichum.*

— **graminis** Fuckel. **27** (L, 44*, 1912); **23** (XX, 894); **65** (XXX, 344); **71** (XL, 54). On grasses. The species has been transferred to *Passalora* by von Höhnel and to *Cercospora* by Horsfall in *Mem. Cornell Agr. Exp. Sta.* 130.

— **melophthorum** Prill & Del. Mentioned **56** (XXI, p. clxxxvii, 1898) and **5**, 468. On melons. Von Höhnel in *Centralbl. Bakt.* Abt. 2, LX, 8 refers it to *Cladosporium cucumerinum.*

— **phomoides** Cooke & Massee in **14** (XVI, 79, 1888); Sacc. X, 600. On dead *Ophiopogon*, Kew.

— **sticticum** (Berk. & Br.) Sacc. in *Syll.* IV, 349; **8**, 391*; **89**, 242*. *Helminthosporium* B. & Br. in **19** (2, XIII, 461*, No. 758, 1854); **15**, 573; Vize Exs. 175. On grasses.

— **uniseptatum** (Berk. & Curt.) Cooke in **14** (XVII, 41, 1888); Sacc. X, 601; **14** (XVII, 53). As *Cladotrichum uniseptatum* (B. & C.) Sacc., non Cooke: Vize Exs. 578. On wood.

Trichocladium asperum Harz. **33** (XVI, 85*, 1902); **27** (XLI, 259*); **116**, 150. On rabbit dung, roots, etc.

Trichothecium inaequale Massee & Salm. in **33** (XVI, 84*, 1902); Sacc. XVIII, 539; **27** (XLI, 259*). On dung of horse, etc.

— **piriferum** (Fr.) Sacc. **8**, 337; **28** (VI, 87); **71** (XXVIII, 149). As *Dactylium*: **20** 345, 1836; **15**, 607. On stems.

— **roseum** Link ex Fr. **120**, 550, 1821; **51**, 465; **39**, t. 172; **20**, 348; **8**, 337*; **27** (L, 14); **28** (VI, 37*; XIX, 147); **34** (XXV, 95); **112**, 332; **67** (CVB, 375); **116**; **70** (1929, 314*); Berk. Exs. 99; Cooke Exs. 354 and II, No. 343. *Dactylium* Berk. in **19**, No. 242; **15**, 608; Vize Exs. 80. As *Cephalothecium*: **28** (X, 111); **66** (CCXXB, 106); **78** (1938, 39). As *C. candidum* Bon.: **8**, 338; **27** (XXXV, 8). As *Trichothecium candidum* Wallr.: **8**, 337; **66** (CXCVIIB, 7). *T. obovatum* (Berk.) Sacc. in *Syll.* IV, 179; **8**, 337; **71** (XXVIII, 149). *Dactylium obovatum* Berk. in **19** (1, VI, 437*, No. 242, 1841); **15**, 608. A common mould.

XEROSPORAE—PHRAGMOSPORAE

Acrothecium delicatulum Berk. & Br. in **19** (3, XV, 402*, No. 1055, 1865); Sacc. IV, 485; **15**, 579; **8**, 420; **40** (IX, 172). On wood. See Mason, *Annotated Acc.* List II, Fasc. 1, on *Acrothecium.*

— **obovatum** Cooke in **14** (V, 50*, 1876); Sacc. IV, 484; **27** (XXIV, 203); **8**, 421. On wood.

— **simplex** Berk. & Br. in **19** (3, VII, 382*, No. 950, 1861); Sacc. IV, 485, with note by Grove; **15**, 579*; **73** (III, 73*); **8**, 421*. On nettle stems, Batheaston.

— **simplex** var. **elatum** Grove in Sacc., *Syll.* IV, 486; **27** (XXIV, 203, 1886); **8**, 421. On nettle stems, Worcs.

— **tenebrosum** (Preuss) Sacc. **27** (XXIII, 168*, 1885); **8**, 421. On wood, Warwicks.

— **xylogenum** Grove in **27** (XXIV, 203*, 1886); Sacc. X, 662; **8**, 422. On wood, Worcs.

Arthrobotryum atrum Berk. & Br. in **19** (3, III, 361*, No. 822, 1859); Sacc. IV, 629; **15**, 563*; **73** (III, 73*); **8**, 460*; **46** (IV, 58); **7**, 347; Rabenh. Exs. 65 as '*A. Broomii*'. On herbs.

— **stilboideum** Ces. B. & Br. **19** (3, VII, 381, No. 943, 1861); **15**, 563; **8**, 460; **7**, 347; Rabenh. Exs. 978. On wood.

Arthrosporium elatum Massee in **37** (1913, 199*); Sacc. XXV, 929, with suggestion that it is a *Didymostilbe*. On grass, Kew. Spores said to be one-septate.

Bactridium acutum Berk. & White in **40** (IV, 162*, 1877); **19** (5, I, 26*, No. 1704, 1878); Sacc. IV, 692; **8**, 477; **13**, 230. On *Peziza*, Scotland.

— **atrovirens** Berk. in **20**, 350, 1836; Sacc. IV, 693; **15**, 480; **8**, 478, 'no specimen'. On wood, Northants.

— **flavum** Kunze ex Fr. Berk. Exs. 327, 1843; **15**, 479*; **8**, 477; **46** (II, 214); **48** (V, 9); **7**, 348; **71** (XL, 55); Cooke Exs. 542; Vize Exs. 118. On wood.

— **Helvellae** Berk. & Br. in **19** (3, III, 360*, No. 816, 1859); Sacc. IV, 692; **15**, 479; **8**, 477*. On a *Peziza*, Batheaston.

Brachycladium botryoides A. L. Smith in **27** (XLI, 258*, 1903). *Dendryphium* Sacc. in *Syll.* XVIII, 593. On germinating grass seeds, Norwood. Miss Smith revived Corda's genus *Brachycladium* for *Dendryphium*-like fungi with conidia not catenulate. Ferraris in 1912 (*Flora Ital. Crypt.*, *Hyphales*, p. 455) independently revived *Brachycladium*.

— **curtum** (Berk. & Br.) A. L. Smith in **27** (XLI, 259, 1903); Ferraris, loc. cit. *Dendryphium* B. & Br. in **19** (2, VII, 176*, No. 538, 1851); Sacc. IV, 489; **15**, 564*; **46** (II, 215); **8**, 424; **7**, 342; **73** (1873); Cooke Exs. 357 and II, No. 357. On stems. Miss Smith **28** (VI, 157, as *Dendryphium*) found catenulate spores, 'probably due to the very sheltered laboratory conditions'. This discovery may mean that *Brachycladium* is not tenable.

— **laxum** (Berk. & Br.) A. L. Smith in **27** (XLI, 259, 1903). *Dendryphium* B. & Br. in **19** (2, VII, 176*, No. 539, 1851); Sacc. IV, 490; **15**, 564; **13**, 268; **8**, 424. On stems.

— **penicillatum** Corda. **40** (X, 282, 1890) as *Dendryphium*. On nettle stems, Aberdeen.

— **ramosum** (Cooke) A. L. Smith in **27** (XLI, 259, 1903); Ferraris, loc. cit. *Dendryphium* Cooke in **15**, 464, 1871; Sacc. IV, 489; **73** (IV, 1877, t. 24); **40** (VIII, 228); **8**, 424; Cooke Exs. 294 and II, No. 354. On stems.

Brachysporium altum (Preuss) Sacc. **8**, 413. As *Helminthosporium*: **19** (3, VII, 382, No. 948, 1861); **15**, 574. On wood, Twycross.

— **apicale** (Berk. & Br.) Sacc. in *Syll.* IV, 426; **46** (II, 347); **8**, 413; **7**, 342. *Helminthosporium* B. & Br. in **19** (3, VII, 382*, No. 947, 1861); **15**, 574; **13**, 271; Cooke Exs. II, No. 355. On wood.

— **biseptatum** Sacc. & Roum. **8**, 414, 1893. On stems.

— **Bloxami** (Cooke) Sacc. in *Syll.* IV, 426; **8**, 413; *Helminthosporium* Cooke in **14** (XII, 36, 1883). On wood, Twycross.

— **ellipticum** (Berk. & Br.) Massee in **8**, 414, 1893. *Monotospora* B. & Br. in **19** (5, VII, 130*, No. 1909, 1881); Sacc. IV, 300. On stems.

— **hyalospermum** (Corda) Sacc. **14** (XVI, 108, 1888); **8**, 413. On wood, Twycross.

— **obovatum** (Berk.) Sacc. in *Syll.* IV, 427; **8**, 414*; **7**, 342. *Helminthosporium* Berk. in **19** (1, VI, 434*, No. 232, 1841); **15**, 573. On wood.

— **oosporum** (Corda) Sacc. **8**, 412; **7**, 342; **28** (VI, 87). As *Helminthosporium*: **19**, No. 944, 1861; **15**, 574*; **40** (IX, 172). On wood.

— **Salisburiae** (Rabenh.) Sacc. **14** (XVI, 108, 1888); **8**, 412. On leaves of *Salisburia*, Kew.

— **stemphylioides** (Corda) Sacc. **40** (IX, 172); **8**, 412; **7**, 342. As *Helminthosporium*: **73** (IV, 5*, 1877); **13**, 271; **27** (XXII, 200); **68** (1885, 758); Cooke Exs. II, No. 642. On wood.

— **tingens** (Cooke) Sacc. in *Syll.* IV, 427; **8**, 414; **7**, 342; *Helminthosporium* Cooke in **14** (XII, 37, 1883). On wood.

— **Wakefieldiae** Massee in **37** (1913, 198*); Sacc. XXV, 835. On a *Corticium*, Kew.

Ceratophorum setosum Kirchn. **56** (LVIII, 144*, 1933); **79** (XIII, 29); **22** (Bull. 79, p. 97). On *Lupinus*.

Cercospora Apii Fres. **28** (XXII, 11, 1938). Rare on *Apium*; see Brooks, **112**, 343.

— **bacilligera** (Berk. & Br.) Wollenw. in *Fusaria Autog. Del.* No. 450 and **102** (XV, 28, 1917). *Fusisporium* B. & Br. in **19** (2, VII, 178, No. 548, 1851); **15**, 621. *Fusarium* Sacc. in *Syll.* IV, 711; **8**, 483. On *Rhamnus*, 'west of England.'

Cercospora beticola Sacc. **37** (1906, 52*); **5**, 490; **25** (XXVII, 22); **112**, 342; **22**, Bull. 79; **93**, 41. On *Beta*.
[— **Bolleana** (Thum.) Speg. Indefinite reference, **89**, 164. On *Ficus*.]
— **Calendulae** Sacc. **35** (1909, 419; 1911, 166). On *Calendula*, Yorks.
— **cantuariensis** Salm. & Wormald in **27** (LXI, 134, 1923); **23** (XXX, 433*); **28** (XIII, 32*); **112**, 343; **77** (1924, 109; 1928–30, 131). On *Humulus*.
— **circumscissa** Sacc. **23** (XIV, 221, 1907; XV, 440; XVII, 211); **5**, 483*; **115**, 102. On *Prunus*.
— **Comari** Peck. **40** (IX, 172, 1887). On *Potentilla Comarum*, Scotland.
— **concentrica** Cooke & Ellis. **8**, 416, 1893. On *Yucca*.
— **dubia** (Riess) Wint. **27** (LVI, 345*, 1918). On *Atriplex*, Worcs.
— **Fabae** Fautr. **78** (1930, 131); **28** (XVII, 195*); **22**, Bull. 79; **23** (XLIII, 1047). On *Vicia Faba*.
— **ferruginea** Fuckel. **27** (XXIV, 204, 1886); **8**, 416. On *Artemisia*, Worcs.
— **Ii** Trail in **40** (X, 75, 1889); Sacc. X, 620; **89**, 29; **28** (III, 373). On *Viola*, Scotland.
— **lilacina** Bres. **28** (XXII, 11, 1938). On *Viola*, Ireland.
— **Lythri** (Westend.) Niessl. Recorded **28** (XXII, 11, 1938), Ireland.
— **Melonis** Cooke in **31** (3, XX, 271, 1896) and **23** (IX, 196*, 1902); Sacc. XVIII, 598; **5B** (Ed. 2, 455); **5**, 484; **23** (X, 166; XII, 19; XV, 357; XXIX, 469); **89**, 101*; **66** (CXCVII B, 7); **78** (1914, 141); **79** (V, 29; XI, 48); **85** (XXVII, 88); **112**, 342; **31** (3, LXXXVI, 449); **56** (LVII, 63); **22**, Bull. 79; *Corynespora Mazei* Gussow gen.nov. in **63** (LXV, 272, 1904). On *Cucumis*.
— **Mercurialis** Pass. **40** (VII, 228, 1886; X, 67); **8**, 416; **7**, 342. On *Mercurialis*.
— **microsora** Sacc. **40** (X, 67, 1889). On *Tilia*, Scotland.
— **moricola** Cooke in **14** (XII, 30 (British record on p. 37), 1883); Sacc. IV, 475; **8**, 416; **89**, 139*. On *Morus*.
— **Myrti** Erikss. **28** (VI, 157, 1919). On *Myrtus*, Scotland.
— **Odontoglossi** Prill. & Del. **5**, 489, 1910; **82** (XIII, 32). On *Odontoglossum*.
— **Opuli** (Fuckel) von Höhnel. **28** (XI, 18, 1926). On *Viburnum*, Ireland.
— **Resedae** Fuckel. **8**, 415*; **5B**, 319 and 438; **89**, 22*; **5**, 489; **70** (1936, 417); Cooke Exs. II, No. 162 (see **14** (IV, 130)). *Virgasporium maculatum* Cooke gen.nov. in **14** (III, 182, 1875); Sacc. IV, 435; **73** (1877, t. 25). On *Reseda odorata*.
— **Roesleri** (Cattan.) Sacc. **23** (XV, 441, 1908) as *Cladosporium*. On *Vitis*, Blairgowrie.
— **Rubi** Sacc. Recorded **28** (XII, 5, 1927), Arundel. See **5**, 489.
— **salina** Sutherland in **32** (XV, 43*, 1916); Sacc. XXV, 895; **28** (V, 432). On sea-weeds.
— **scandicearum** Magnus. **70** (1936, 417). On *Caucalis*, Ireland.
— **Veronicae** A. L. Smith & Ramsb. in **28** (V, 243, 1916); Sacc. XXV, 891. On *Veronica*, Scotland.
— **Violae** Sacc. **56** (XXVII, 28*, 1902); **5B**, 319 and 438; **5**, 488; **112**, 343. On *Viola*.
[**Cercosporella Antirrhini** Wakef. in **37** (1918, 233) is a *Pseudodiscosia*; see **28** (XIV, 220) and Grove **1** (II, 286).]
— **Brassicae** (Fautr. & Roum.) von Höhnel. **79** (XI, 45). E. W. Mason **28** (XX, 110) points out that the type specimen of *Cercospora Bloxami* B. & Br. is *Alternaria Brassicae* (q.v.), but many subsequent records belong to *Cercosporella Brassicae*. As *Cercospora Bloxami*: **25** (V, 438, 1905); **56** (XXVII, 802); **79** (I, V, IX); **22**, Bull. 79. On *Brassica*.
— **Filicis-foeminae** (Bres.) von Höhnel. **28** (XIII, 306, 1928). On *Athyrium*, Scotland.
— **herpotrichoides** Fron. **28** (XX, 120, 1936); **78** (1937, 112); **93**; *Agric. Prog.* XVI, 1. On *Triticum*.
— **Oxalidis** Grove in **27** (LX, 175*, 1922). On *Oxalis*, Surrey.
— **Pastinacae** Karst. **37** (1918, 19*); **112**, 335. On *Pastinaca*.
— **Virgaureae** (Thüm.) Allesch. **28** (V, 166, 1915). On *Solidago*, Scotland.

Clasterosporium abruptum (Berk. & Br.) Sacc. in *Syll.* IV, 389; **8**, 401; **7**, 341. *Sporidesmium* B. & Br. in **19** (3, XV, 401*, No. 1042, 1865); **15**, 486. On wood.

— **carpophilum** (Lév.) Aderh. **22** (Misc. Publ. 38, p. 82, 1922); **33** (XLI, 375*); **112**, 338; **79** (V, VI, IX, XI); **34** (XVII, 297*); **65** (XXX, 339); **22**, Bull. 79. On *Prunus*. See *Helminthosporium rhabdiferum.*

— **caulicola** (Corda) Sacc. **14** (XVI, 107, 1888); **8**, 402. Grove transferred this to *Bactrodesmium* and proposed var. *pellucidum* in **27** (XXIV, 200*, 1886). On stems.

— **claviforme** (Preuss) Sacc. **8**, 402, 1893. On wood.

— **claviforme** var. **leptopus** Sacc. **14** (XVI, 107, 1888); **8**, 402. On wood.

— **fasciculare** (Corda) Sacc. **14** (XVI, 106, 1888); **40** (X, 282); **8**, 401. On wood.

— **fungorum** (Fr.) Sacc. **8**, 401; **7**, 341; **35** (1907, 289). As *Epochnium*: **20**, 352; Berk. Exs. 54. *Sporidesmium* Berk. in **18**, 327; **15**, 865. As '*S. atrum*': **39**, t. 194, 1826; **68** (2, V, 758*). On *Corticium*, etc.

— **maculans** (Corda) Sacc. **40** (X, 282, 1890). On wood, Scotland.

— **opacum** (Corda) Sacc. **8**, 401; **71** (XXVIII, 149); **35** (1913, 28). As *Sporidesmium*: **19** (3, XVIII, 121*, No. 1145, 1866); **15**, 485. On wood.

— **parasiticum** (Cooke) Sacc. in *Syll.* IV, 392; **8**, 402; **89**, 139*. *Sporidesmium* Cooke in **31** (Nov. 10, 1877, p. 599) and **14** (VI, 74*, Dec. 1877). On leaves of *Morus*.

— **vermiculatum** Cooke in **14** (IV, 69, 1875); **73** (1877, t. 25); Sacc. IV, 384; **8**, 400*. On wood.

Dactylaria orchidis Cooke & Massee in **14** (XIX, 42, 1890); Sacc. X, 553; **8**, 344. On old *Oncidium*, Kew. See **100** (XXIX, 516).

Dactylella ellipsospora (Preuss) Grove in **27** (XXIV, 200*, 1886); Sacc. IV, 194; **8**, 343; **28** (VI, 157); **100** (XXIX, 492). On wood.

— **implexa** (Berk. & Br.) Sacc. in *Syll.* IV, 194; **8**, 343*; *Dactylium* B. & Br. in **19** (4, XI, 345*, No. 1381, 1873). Inside a willow, Hereford.

— **minuta** Grove gen.nov. in **27** (XXII, 199*, 1884); Sacc. IV, 193; **8**, 342. On wood, Warwicks.

— **minuta** var. **fusiformis** Grove in **27** (XXII, 200*, 1884); Sacc. IV, 194; **8**, 343. On *Carduus*, Warwicks.

— **plumicola** Grove in **27** (LIV, 220*, 1916); Sacc. XXV, 723. On feathers, Birmingham.

— **rhombospora** Grove in **27** (XXIII, 166*, 1885); Sacc. IV, 194; **8**, 343. On wood, Birmingham.

Dactylium dendroides Fr. **20**, 345, 1836; **73** (1871, t. 4); **15**, 778; **14** (XI, 42*); **8**, 341*; **7**, 335; **71** (XLII, 53); **85** (XXIX, 22; XXXI, 16); **28** (XXI, 273). As *Botrytis agaricina* Link: **51**, 468, 1824; **39**, t. 126; **58**, 212. *Verticillium agaricinum* (Bon.) Cooke [non Corda] in **14** (I, 184); **14** (II, 139*). On agarics and in mushroom beds; stage of *Hypomyces rosellus.*

— **Lycopersici** Plowr. in **31** (2, XVI, 621*, 1881); **89**, 97. On *Lycopersicum.*

[— **tenuissimum** Berk. was withdrawn in **19**, No. 537.]

Dendryphium comosum Wallr. **19** (3, III, 361, No. 820, 1859); **15**, 563; **8**, 423; **7**, 342; **23** (X, 166*; XI, 153); **89**, 103; **66** (CXCVIIB, 7); **37** (1911, 377); **48** (XX, 181). On stems and said to be a parasite of *Cucumis*.—See also *Brachycladium.*

— **fumosum** (Corda) Fr. **15**, 565; **73** (1871, t. 5); **8**, 423; *Helminthosporium fumosum* (Corda) Currey in **68A** (1857, 116*). On stems.

— **griseum** Berk. & Br. in **19** (2, VII, 177*, No. 540, 1851); Sacc. IV, 489; **15**, 564; **73** (1873); **8**, 423*. On stems.

Exosporium hysterioides (Corda) von Höhnel. As *Torula*: **19** (2, XIII, 460, No. 751, 1854); **15**, 477; **13**, 228; Vize Exs. 320. As *Hormiscium*: **8**, 364. On wood. See *Dictyosporium toruloides.*

— **laricinum** Massee in **37** (1907, 242*); Sacc. XXV, 992; **5**, 480; **23** (XX, 1085). As *Exosporium* sp.: **23** (IX, 183*, 1902). On *Larix*, etc.

Exosporium Tiliae Link ex Wallr. **39**, t. 208, 1826; **8**, 491*; **5**, 481. As *Helminthosporium*: **20**, 337; **19** (I, VI, 434*, No. 230); **15**, 572; **13**, 270; **71** (XXVIII, 149); Cooke Exs. II, No. 356. On *Tilia*. Massee **8**, 407, claimed that *Helminthosporium Tiliae* Fr. is distinct from *Exosporium*.

Fusariella atrovirens (Berk.) Sacc. in *Syll.* IV, 395; **8**, 403*; **89**, 104*; **5**, 497. *Fusisporium* Berk. in **20**, 351, 1836; **15**, 621; **81**, 49. On *Allium*.

Helminthosporium apiculatum Corda. **19** (3, VII, 381, No. 945, 1861); **15**, 574; **13**, 271; **8**, 409; **7**, 341; Cooke Exs. II, No. 359; Vize Exs. 66. On wood, etc.

— **Avenae** Eidam. **79** (I, 28, 1924; V, 27; IX, 19; XI); **24** (XIII, 272*; XV, 1 and 406); **87** (VIII, 131); **34** (XVIII, 535); **28** (XVI, 257; XVIII, 223*; XX, 112); **61** (CXXXI, 435); **71** (XL, 55); **47** (5, XLVI, 91); Res. Bull. 3, West of Scotland Agric. College, 1933; **25** (XXXII, 246); **49** (IV, 113); **22**, Bull. 79; **78** (1937, 115); **33** (2, II, 699). On *Avena*; *Pyrenophora* stage recorded **28** (XIX, 288).

— **capitulatum** Corda. **14** (XVI, 107, 1888); **8**, 405. On wood.

— **cylindricum** Corda. **27** (XXIII, 168, 1885); **8**, 405. On wood.

— **delicatulum** Berk. in **19** (I, VI, 435*, No. 233, 1841); Sacc. IV, 410; **15**, 573; **13**, 270; **8**, 407; **46** (III, 65). *Macrosporium* Cooke in **14** (XVI, 112); **8**, 433. On stems.

— **dendroideum** Berk. & Br. in **19** (3, VII, 381*, No. 946, 1861); Sacc. IV, 415; **15**, 575; **8**, 409; **7**, 341. On wood.

— **densum** Sacc. & Roum. **14** (XVI, 108, 1888); **8**, 410. On *Morus*, Kew.

— **folliculatum** Corda. **19** (I, VI, 434, No. 231, 1841); **15**, 570; **73** (1877, 6); **13**, 270; **8**, 409; **7**, 341; Cooke Exs. 544 and II, No. 168; Vize Exs. 135. On stems.

— **folliculatum** var. **brevipilum** Corda. **46** (III, 266*, 1882); **27** (XXII, 200). On wood.

— **fusiforme** Corda. **73** (1877, t. 24); **13**, 271; **8**, 408*; **28** (I, 164); Vize Exs. 65. On wood.

— **fusisporum** Berk. in **20**, 336, 1836; Sacc. IV, 418; **15**, 571; **46** (II, 216); **8**, 410. On wood.

— **gongrotrichum** Corda. **14** (XVI, 108, 1888); **8**, 409. On wood.

— **gramineum** Rabenh. **28** (I, 151, 1901 and p. 184, 1902); **68** (1901, 615); **5B**, 315 and 437; **25** (III, 18, 1902; XXV, XXVIII, XXIX, XXX); **23** (XII, XIV); **69** (I, 367); **22** (Misc. Publ. 38); *Proc. Cambridge Phil. Soc.* (Biol. Sci.), I, 132; **79** (I, III–V, X, XI); **85** (XXIV, 149); **28** (XVI, 256); **78** (1937, 117); **34** (XVI, 236). On *Hordeum*. See **110** (XXIV, 641).

— **Gymnostachyi** Pim in **71** (1884, 285); **71** (XXVIII, 149). On *Gymnostachyum*, Ireland.

— **hirudo** Sacc. var. **anglicum** Grove in **27** (XXIV, 202*, 1886). On wood, Warwicks. This variety and the next were entered in *Syll.* IV, 383 (Apr. 1886) and **8**, 400 under *Clasterosporium*.

— **hirudo** var. **minus** Grove, loc. cit. On wood, Warwicks. Grove considered *H. obclavatum* a younger state.

— **hormiscioides** (Corda) Sacc. **27** (XXIV, 202, 1886); **8**, 400 as *Clasterosporium*. On wood, Warwicks.

— **inconspicuum** Cooke & Ellis. **27** (L, 44*, 1912). On grass leaves, Staffs. The name is a synonym of *H. turcicum* Pass. teste Drechsler **110** (XXIV, 641).

— **inconspicuum** var. **britannicum** Grove in **27** (XXIII, 168, 1885); Sacc. IV, 412; **8**, 408. On grass leaves, Warwicks.

[— **interseminatum** Berk. & Rav. Recorded **102** (X, 469*), but E. W. Mason, *Annotated Acc.* List II, Fasc. 1, p. 5, considered it an *Acrothecium*. See *Dendryphiella* in **102** (XII, 417).]

— **macilentum** Cooke in **14** (VI, 74*, 1877); Sacc. IV, 418; **8**, 411. On wood.

[— **macrocarpum** Grev. ex Fr. in *Systema* III, 356; **39**, t. 148, 1825; Sacc. IV, 412; **20**, 336; **15**, 571; **73** (1877, 6); **13**, 270; **8**, 408; **7**, 341; **71** (XL, 55); Vize Fungi Brit. 177; Cooke Exs. 543 and II, No. 358. *Sphaeria ciliaris* Sow. in **42**, t. 339, 1801. On wood. As Tulasne **114** (II, 277) noted, *H. macrocarpum* is a synonym of *H. velutinum*, q.v.]

Helminthosporium microsorum D. Sacc. **27** (LXXVI, 359, 1938). On *Quercus Ilex*, Cornwall.

— **minimum** Cooke in **14** (XVI, 80, 1888); Sacc. x, 613; **8**, 406. On wood, Hereford.

— **molle** Berk. & Curt. **19** (5, VII, 130, No. 1910, 1881); **14** (x, 49); **8**, 406; **71** (XXVIII, 149). On branches.

— **nanum** Nees ex Fr. **120**, 556, 1821; **20**, 336; **15**, 572; **40** (V, VI, VIII); **8**, 407. On wood, etc.

— **obclavatum** Sacc. **27** (XXII, 200*, 1884; XXIV, 202); **28** (I, 194); **8**, 410. On wood. See *H. hirudo*.

— **parvum** Grove in **27** (XXIV, 203*, 1886); Sacc. x, 610; **14** (XVI, 108); **8**, 406. On wood, etc.

— **resinaceum** Cooke in **14** (XVII, 68, 1889); Sacc. x, 610. On pine resin, Shere.

— **reticulatum** Cooke in **15**, 576, 1871; Sacc. x, 610; **14** (XVI, 108; XVII, 68); Cooke Exs. 360. On dead ash leaves.

[— **rhabdiferum** (Berk.) Berk. apud B. & Br. in **19** (3, XV, 402, No. 1053, 1865); Sacc. IV, 419; **15**, 575; **8**, 411; **56** (XXXIII, 527); **89**, 134*; *Macrosporium* Berk. in **31** (1864, 938*). On ripe peaches. Lindau, Lind, and others consider it a synonym of *Clasterosporium carpophilum*.]

— **rhopaloides** Fres. **14** (v, 58, 1876); **73** (1877, t. 24); **27** (XXII, 200); **8**, 411; **7**, 341; **28** (III, 148); Cooke Exs. II, No. 448; Vize Exs. 68. On stems.

— **Rousselianum** Mont. **19** (2, VII, 98, No. 508 bis, 1851); **15**, 572; **73** (1877, 73); **13**, 270; **8**, 407. On wood.

— **sativum** Pammel, King & Bakke. *Proc. Camb. Phil. Soc.* (Biol. Sci.), I, 1924; **28** (XVI, 253*); **22**, Bull. 79. Causes foot-rot of *Triticum* and *Hordeum*.

— **scolecoides** Corda. **19** (3, XV, 402, No. 1052, 1865); **15**, 574; **8**, 409. On stems, etc.

— **simplex** Kunze ex Fr. **20**, 337, 1836; **15**, 572; **8**, 405; **71** (2, IV, 27). On wood.

— **Smithii** Berk. & Br. in **19** (2, VII, 97*, No. 507, 1851); Sacc. IV, 416; **68A** (V, 115*); **73** (II, t. 7); **15**, 570; **13**, 269; **8**, 410; **7**, 341; Vize Exs. 136; Cooke Exs. 361 and II, No. 357. On *Ilex*, etc.

— **subulatum** Nees ex Fr. **20**, 336, 1836; **15**, 571; **13**, 270; **8**, 407; **46** (III, 65). On oak branches.

— **teres** Sacc. **23** (XIV, 356, 1907); **5**, 482; **24** (V, 415); **65** (XXX, 344); **34** (XVI); **85** (XXVIII, 49; XXIX, 16; XXXI, 13); **25** (XXXII, 73); **78** (1937, 117). On *Hordeum*. Some of the records are as *Pyrenophora*, but perithecia are apparently unknown in Britain.

[— **Tiliae** Fr. See *Exosporium*.]

— **turbinatum** Berk. & Br. in **19** (2, VII, 98*, No. 508, 1851); Sacc. IV, 418; **15**, 572; **46** (II, 347); **8**, 411. On wood.

— **velatum** Corda. **14** (XVI, 108, 1888); **8**, 411. On wood.

— **velutinum** Link ex Fr. **120**, 557, 1821; **39**, t. 148; **20**, 336; **15**, 571; **13**, 270; **8**, 405; **7**, 341; Cooke Exs. 358 and II, No. 358. On wood; the type species of *Helminthosporium*. The spores are multi-septate, not three-septate as stated by Saccardo. See *H. macrocarpum*.

— **Warpuriae** Wakef. in **37** (1918, 233); Sacc. XXV, 818. On *Warpuria*, Kew.

Heterosporium Allii Ellis & Martin var. **cepivorum** Nicolas & Aggéry. **85** (XXIX, 17, 1932); **22**, Bull. 79. On *Allium*.

— **Auriculae** Cooke in **56** (XXVII, 380*, 1902); Sacc. XVIII, 1384; **5**, 498; **112**, 339; nom. nud. **14** (XVI, 109, 1888). On *Auricula*.

— **echinulatum** (Berk.) Cooke in **14** (V, 123, 1877); Sacc. IV, 481; **73** (1877, 9); **8**, 417; **5B**, 319*; **56** (XXVI, 650 and p. CXXX; XXVII, 34*); **5**, 497*; **23** (XX, 799; XLIII, 1047); **79** (IV, V, VII, VIII, XI); **71** (XLII, 54); **85** (XXXIII, 21); **22**, Bull. 79; **112**, 339. *Helminthosporium* Berk. in **31** (1870, 382*); **15**, 575; **31** (XXVI, 244*); Cooke Exs. II, No. 360; Vize Exs. 67. *Helminthosporium exasperatum* B. & Br. in **19** (4, XI, 345*, No. 1380, 1873); Sacc. IV, 407 and 481; **14** (II, 138; V, 123); **56** (XV, p. xlii); **8**, 406; *Heterosporium exasperatum* (B. & Br.)

Cooke in **14** (XVI, 109). On *Dianthus*, stage of *Didymellina Dianthi* C. C. Burt in **28** (XX, 214). Cooke at first (**14** (V, 123)) stated that the epithets *echinulatum* and *exasperatum* referred to the same fungus, then **14** (XVI, 109; XVII, 21) stated that *Heterosporium echinulatum* grows upon Monocotyledons. In **89**, 35, he went back to the correct view. Meanwhile Massee **8**, listed *Helminthosporium exasperatum* on p. 406 on *Dianthus* and *Silene*, and on p. 418 as a synonym of *Heterosporium Ornithogali* on Monocotyledons; the '*H. asperatum* (Berk.) Massee' in **68** (1892, 577*) and Sacc. XXII, 1388 is one more exasperating reference, this time evidently to *H. Ornithogali* (there is no specimen in Herb. Kew. marked '*H. asperatum*'). Finally Massee **37** (Add. ser. V, 180, 1906) listed '*H. echinulatum*' on *Convallaria*; see **22** (Bull. 117, p. 59). See *H. Ornithogali* and *H. variabile*.

Heterosporium epimyces Cooke & Massee in **14** (XVI, 80, 1888); Sacc. X, 660; **8**, 419; **7**, 342; **28** (III, 17). On *Boletus*, etc.

— **gracile** Sacc. **31** (3, XV, 718, 1894); **56** (XXVI, 450; XXVII, 398*); **27** (L, 45*); **56** (XL, 481*); **23** (XXII, 363; XXXII, 546); **62** (VIII, 205); **79** (IV–XII); **65** (XXX, 346); **71** (XLII, 54); (**22** Bull. 117). On *Iris*. The fungus was said to occur also on *Freesia*, *Antholyza* and *Hemerocallis*, e.g. **5B**, 321; **56** (XXVI); **5**, 499, and on *Narcissus* **56** (XXVIII, 679).

— **Laricis** Cooke & Massee in **14** (XVI, 80, 1888); Sacc. X, 658; **8**, 418. On fading leaves of *Larix*, Norfolk.

[— **maculatum** Kl. ex Cooke in **14** (XVII, 65, 1889). This was based on Klotzsch Exs., Herb. Myc. 67, from the continent. There is no other specimen at Kew.]

— **Magnusianum** Jaap. **70** (1936, 70); **28** (XXII, 11). On *Narthecium*, Ireland.

— **minutulum** Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 659; **8**, 418; **89**, 175*. On *Chamaerops*, Kew; recorded **23** (II, 441) on *Humulus*.

— **Ornithogali** Kl. ex Cooke gen.nov. in **14** (V, 123, 1877); Sacc. IV, 480; **73** (1877, 8*); **8**, 418; **31** (3, I, 840; III, 658); **89**, 67*; **22** (Bull. 117); Vize Exs. 70. On *Ornithogalum*. See other references under *H. echinulatum*.

— **Syringae** Klebahn. Massee **37** (1911, 82*) as *Helminthosporium* [comb.nov.?]. On *Syringa*. There is an earlier *Heterosporium Syringae* Oudem.; see **5**, 568; it was reported **79** (XV, 39).

— **Typharum** Cooke & Massee in **14** (XVI, 80, 1888); Sacc. X, 660; **8**, 419*. On *Typha*, Kew. Cooke **14** (XVI, 109) listed it and also '*Heterosporium Phragmitis* var. *Typharum*'. The single specimen in Kew Herb., coll. Kew, 1887, still bears the latter nomen nudum; no specimen is marked *H. Typharum*.

— **variabile** Cooke in **14** (V, 123, 1877); Sacc. IV, 480; **73** (1877, t. 25); **8**, 417; **89**, 99*; **5**, 499; **93**; **31** (3, CVI, 100). For a time this was thought to be a synonym of *H. echinulatum*; see **14** (IV, 130; V, 43); **31** (XXVI, 244). The fungus was first issued as *Helminthosporium variabile*, nomen nudum, in Cooke Exs. 360. On *Spinacia*.

Isariopsis Acanthacearum Cooke in **14** (XIX, 8, 1890); Sacc. X, 700. On leaves of *Erianthemum* and *Daedalacanthus*.

— **alborosella** (Desm.) Sacc. **40** (IX, 41, 1887; X, 76); **108** (IX, 52); **70** (1936, 417). On *Cerastium*.

— **carnea** Oudem. **40** (IX, 41, 1887; X, 68). On *Lathyrus*, Scotland.

— **Stellariae** Trail in **40** (X, 76, 1889); Sacc. X, 700. On *Stellaria*, Scotland. Conidia said to be continuous.

Mucrosporium sphaerocephalum (Berk.) Sacc. in *Syll.* IV, 190; **8**, 342*; **27** (XXXV, 8); **7**, 335; **28** (II, 47). *Dactylium* Berk. in **19** (I, VI, 437*, No. 243, 1841); **15**, 607*. On twigs, etc.

Napicladium arundinaceum (Corda) Sacc. **8**, 419*; **28** (XXI, 221). As *Helminthosporium*: **14** (II, 186, 1874); Vize Fungi Brit. 176; Cooke Exs. 646 and II, No. 157. On *Phragmites*.

— **Brunaudii** Sacc. **71** (XXVIII, 149, 1910). Ireland.

Paraspora triseptata Grove gen.nov. in **27** (XXII, 196*, 1884); Sacc. IV, 222; **8**, 347. On wood, Sutton.

Ramularia acris Lindr. **28** (vi, 374, 1920; vii, 10). On *Ranunculus*.
— **Adoxae** (Rabenh.) Karst. **14** (xiv, 132, 1886); **40** (ix, 172). On *Adoxa*, Scotland.
— **agrestis** Sacc. **40** (ix, 41, 1887). On *Viola*, Scotland.
— **Ajugae** (Niessl) Sacc. **40** (ix, 172, 1887); **28** (iii, 121; iv, 37; v, 363); **70** (1936, 414). On *Ajuga*.
— **Alismatis** Fautr. **70** (1936, 412). On *Alisma*, Ireland.
— **alnicola** Cooke in **14** (xiv, 40, 1885); Sacc. iv, 199; Rabenh. *Krypt.-Fl.* 8, 438; transferred to *Ovularia* by Massee in **8**, 322. On *Alnus*.
— **Angelicae** von Höhnel. **28** (v, 167, 1915). On *Angelica*, Arran.
— **Anthrisci** von Höhnel. **28** (v, 3, 1915); **70** (1936, 414). On *Anthriscus*.
— **Arenariae** A. L. Smith & Ramsb. in **28** (iv, 327, 1914); Sacc. xxv, 726. On *Arenaria*, Scotland.
— **Ari** Fautr. **27** (liv, 221, 1916); **28** (xxiii, 238). On *Arum*.
— **Armoraciae** Fuckel. **14** (ii, 186, 1874; iii, 65); **89**, 85*; **77** (1926–7, 86); Cooke Exs. 638 and ii, No. 170; Vize Exs. 346. *Ovularia* Massee in **8**, 321; **7**, 333. On *Cochlearia Armoracia*.
— **aromatica** (Sacc.) von Höhnel. **28** (iii, 369, 1912). On *Acorus*, Scotland.
— **arvensis** Sacc. **28** (v, 242, 1916; xxi, 4). On *Potentilla*.
— **Asteris** (Phill. & Plowr.) Bubák in **102** (vi, 27, 1908); *Fusidium* Phill. & Plowr. in **14** (vi, 23, 1877). On *Aster*, Norfolk. Perhaps the same as *R. macrospora* var. *Asteris*, **65** (xxx, 345).
— **Barbareae** Peck. **28** (vi, 134, 1919); **70** (1936, 413). On *Barbarea*.
— **beticola** Fautr. & Lamb. **77** (1926–7, 86, 1928); **22** (Bull. 70, etc.). On *Beta*.
— **brunnea** Peck. **28** (vi, 372, 1920). On *Tussilago*, Surrey.
— **calcea** (Desm.) Ces. **40** (vii, 37, 1883; x, 67); **27** (xxiv, 199); **8**, 346; **7**, 336; **70** (1936, 414). On *Nepeta*.
— **Calthae** (Erikss.) Lindr. **28** (vii, 224); **35** (1934, 138); **70** (1936, 413). *Cercospora Calthae* Cooke in **14** (xi, 72, 1882) was referred by its author (ibid. p. 155) to *Cylindrosporium niveum* B. & Br. Later **14** (xvii, 19) Cooke revived his *Cercospora Calthae*; Sacc. x, 618; **8**, 415; **35** (1914, 382). *Cylindrosporium niveum* B. & Br. in **19** (4, xv, 34, No. 1459, 1875); Sacc. iii, 737; see Grove **1** (ii, 297). As '*Ramularia nivea*' in error: **35** (1914, 16 and 147). On *Caltha*.
— **Campanulae-latifoliae** Allesch. **28** (v, 242, 1916). On *Campanula*, Scotland.
— **Cardamines** Syd. **28** (v, 167, 1915). On *Cardamine*, Scotland.
— **Cardui** Karst. **28** (v, 242, 1916; v, 363 and 431). On *Carduus* and *Cirsium*, Scotland.
— **Centaureae** Lindr. **28** (iii, 369, 1912); **70** (1936, 415). On *Centaurea*.
— **Centranthi** Brun. **70** (1936, 415). On *Centranthus*, Ireland.
— **Circaeae** Allesch. Recorded **28** (xxii, 11, 1938), Ireland.
— **Cirsii** Allesch. **28** (vi, 372, 1920; vii, 10; xi, 18). On *Cirsium*.
— **Cochleariae** Cooke in **14** (xi, 155, 1883); Sacc. iv, 201; **40** (vii, 85); *Ovularia* Massee in **8**, 322. On *Cochlearia*, Scotland.
— **Coleosporii** Sacc. Recorded **28** (xxi, 4, 1937), Dovedale.
— **Cryptostegiae** Pim in **14** (viii, 150, 1880); Sacc. iv, 215; **27** (xviii, 345); **8**, 346. On decaying seeds of *Cryptostegia*, Ireland.
— **Cupulariae** Pass. As *Ovularia Inulae* Sacc.: **70** (1936, 412). On *Pulicaria*, Ireland.
— **Doronici** (Sacc.) Grove in **27** (lx, 175, 1922). As *Ovularia*: **14** (xiv, 132, 1886); **28** (iii, 368; vi, 156). On *Doronicum*.
— **Epilobii** Allesch. **28** (xi, 18, 1926); **70** (1936, 413). On *Epilobium*, Ireland. Allescher also wrote the epithet 'Epilobii-palustris'.
— **eximia** Bubák. **28** (iv, 174, 1913). On *Crepis*, Scotland.
— **filaris** Fres. var. **Lappae** Bres. Recorded **28** (xi, 18, 1923; xxii, 11; xxiii, 238). On *Arctium*.
— **Gei** (Fuckel) Lindau. **28** (xxi, 4; xxii, 219); **40** (x, 282, 1890) as *Acrotheca*. On *Geum*.
— **Geranii** Fuckel. **8**, 345; **56** (xxvii, 40); **7**, 336; **28** (iii, 369); **70** (1936, 413); Vize Exs. 75. As *Fusidium Geranii* Westend.: **14** (iii, 77, 1874; iii, 184); **40** (vii,

85); Cooke Exs. 685. On *Geranium*.—Saccardo and others erroneously cite the name as *R. Geranii* (Westend.) Fuckel. Westendorp's epithet is earlier, but Fuckel described his *Ramularia* as a new species, not as a new combination.

Ramularia Hellebori Fuckel. **14** (XIII, 51, 1884); **8**, 344*; **7**, 336; **89**, 11*. On *Helleborus*.

— **Heraclei** (Oudem.) Sacc. **40** (VII, 272, 1884; VIII, 228); **28** (III, 369; IV, 37); **70** (1936, 414). On *Heracleum*.

— **Hypochoeridis** Magnus. **28** (VI, 371, 1920; VII, 10); **71** (XLII, 54). On *Hypochoeris*.

[— **inconspicua** Trail, **40** (IX, 172), nomen nudum.]

— **Keithii** Massee nom.nov. in **8**, 345, 1893, based on *R. Malvae* Fuckel var. *Malvae-moschatae* Sacc. in *Syll.* IV, 205; **28** (IV, 70). As *R. Malvae*: **14** (XI, 72, 1882); **40** (VII, 36). On *Malva moschata*, Scotland.

— **Knautiae** (Massal.) Bubák. **28** (III, 370, 1912; IV, 37; V, 17); **108** (IX, 52). On *Knautia*.

— **Kriegeriana** Bres. Recorded **28** (XXII, 11, 1938). Ireland.

— **lactea** (Desm.) Sacc. **14** (XVI, 65); **89**, 27*, **79** (V, 31); **71** (XLII, 53). As *R. Violae* Fuckel: **14** (IV, 109, 1876); Vize Exs. 341. *Ramularia Violae* Trail in **40** (X, 74, 1889) is a later homonym and probably a synonym of *R. Violae* Fuckel; see **28** (IV, 74; V, 431); **35** (1915, 101). As *Ovularia lactea* (Desm.) Bomm. & Rouss.: **8**, 321; **63** (LXI, 735). On *Viola*.

— **lamiicola** Massal. **28** (III, 370, 1912). On *Lamium*, Scotland.

— **Lampsanae** (Desm.) Sacc. **14** (XIV, 40); **40** (IX, 41; X, 67); **27** (XXIII, 166); **8**, 345; **71** (XLII, 54). *Ovularia* Massee in **8**, 320; **7**, 333. As *Fusidium cylindricum* Corda: **14** (IV, 120, 1876). On *Lapsana* (*Lampsana*).

— **lychnicola** Cooke in **14** (XIV, 40, 1885); Sacc. IV, 204; **56** (XXVI, 650*; XXVII, 35); **28** (IV, 182). *Ovularia* Massee in **8**, 320; **7**, 333. On *Lychnis*.

— **Lysimachiarum** Lindr. **28** (VI, 156, 1919); **108** (IX, 52). On *Lysimachia*.

— **macrospora** Fres. **40** (IX, 41, 1887); **28** (III, 370); **56** (XXXVII, 543); **71** (XLII, 53); **79** (VI, VIII, XIII); **85** (XXVI, 165; XXXIII, 21); **27** (LXXVI, 359). On *Campanula*.

— **macrospora** var. **Senecionis** Sacc. **70** (1936, 415). On *Senecio*, Ireland.

— **menthicola** Sacc. **71** (XLII, 53, 1934). On *Mentha*. *R. menthicola* Trail in **40** (VIII, 228, 1886) is a nomen nudum.

— **necator** Massee in **37** (1907, 243*); Sacc. XVIII, 1314; **5**, 476. On cotyledons of *Theobroma*, Kew; seeds from Jamaica.

— **Nymphaearum** (Allesch.) Ramsb. in **28** (V, 166, 1915); comb.nov. suggested but not made in **56** (XL, p. CXV, 1914). As *Ovularia*: **22** (Bull. 79, p. 94). On *Nymphaea* and *Nuphar*.

— **obducens** Thüm. **70** (1936, 414); **40** (IX, 172, 1887, in error as *R. obducens* 'Peck'). On *Pedicularis*.

— **Parietariae** Pass. **40** (X, 282, 1890); **70** (1936, 412). On *Parietaria*.

— **Pastinacae** Bubák. **37** (1918, 18*). On *Pastinaca*.

— **Petuniae** Cooke in **14** (XX, 8, 1891); Sacc. X, 561; **89**, 61*. On *Petunia*, Plymouth.

— **Picridis** Fautr. & Roum. **108** (IX, 52, 1934). On *Picris*, Evesham.

— **plantaginea** Sacc. & Berl. **40** (IX, 41, 1887); **28** (III, 371; IV, 208; XI, 18); **35** (1914, 147); **62** (XXI, 287); **27** (LXXVI, 359). On *Plantago*. Grove **1** (II, 297) refers here *Cylindrosporium rhabdosporum* B. & Br. in **19** (4, XV, 34, No. 1458, 1875).

— **Plantaginis** Ellis & Martin. **40** (IX, 41, 1887; X, 67); **28** (III, 371; IV, 37 and 220). On *Plantago major*.

— **pratensis** Sacc. **14** (XIII, 51, 1884); **40** (VIII, 228; X, 67); **8**, 347; **35** (1914, 147); **70** (1936, 413). On *Rumex*. Trail recorded a 'variety', **40** (IX, 172).

— **Primulae** Thüm. **56** (XIII, p. clxxvii, 1891; XXVII, 379*); **27** (L, 15*); **35** (1914, 147); **71** (XLII, 54). On *Primula*.

— **pruinosa** Speg. **14** (XI, 15, 1882); **40** (VII, 36; X, 67); **8**, 346; **71** (XLII, 54). On *Senecio*.

Ramularia punctiformis (Schlecht.) von Höhnel. **70** (1936, 414). *R. Epilobii* (Schneid.) Trail in **40** (x, 67 and 74, 1889; x, 282). As *R. montana* Speg.: **40** (IX, 41, 1887); **28** (III, 371). On *Epilobium*. See **102** (VI, 214).
— **purpurascens** Wint. **70** (1936, 415); **28** (XXI, 4); **27** (LXXVI, 359). On *Petasites*.
— **Ranunculi** Peck. **70** (1936, 413); **28** (XXII, 4). On *Ranunculus*.
— **Rapae** Pim in **27** (XXXV, 58, 1897); Sacc. XIV, 1059; **28** (I, 66). On *Brassica Rapa*, Ireland.
— **Rhei** Allesch. **93**, 112; **115**, 98; **28** (XXII, 11). On *Rheum*.
— **rosea** (Fuckel) Sacc. **14** (XIII, 51, 1884); *Ovularia* Massee in **8**, 323. On *Salix*, Norfolk.
— **sambucina** Sacc. **40** (x, 282, 1890); **28** (III, 372); **27** (LIV, 221); **71** (XLII, 53); **108** (IX, 52). On *Sambucus*.
— **Saxifragae** Syd. **70** (1936, 413). On *Saxifraga*, Ireland.
— **scelerata** Cooke in **14** (XIV, 40, 1885); Sacc. IV, 200; *Ovularia* Massee in **8**, 323. On *Ranunculus*, Hants.
— **Schulzeri** Bäuml. **28** (V, 167, 1915). On *Lotus*, Scotland.
— **Scolopendrii** Fautr. **70** (1936, 412); **28** (XXI, 4). On *Phyllitis*.
— **Scrophulariae** Fautr. & Roum. **28** (III, 372, 1912); **27** (LVI, 344); **70** (1936, 414). On *Scrophularia*.
— **Senecionis** (Berk. & Br.) Sacc. in *Syll.* IV, 210; **28** (III, 371). *Cylindrosporium* B. & Br. in **19** (4, XVII, 142, No. 1613, 1876); **1** (II, 198). *Ovularia* Massee in **8**, 321. On *Senecio*, Scotland.
— **Spiraeae** Peck. Recorded **28** (XXI, 4, 1937; XXII, 4 and 11).
— **Stachydis** (Pass.) Massal. Recorded **28** (XXI, 4, 1937 and XXII, 219).
— **Succisae** Sacc. **40** (x, 41, 1887); **70** (1936, 415). On *Scabiosa Succisa*.
— **Tanaceti** Lind. **28** (VI, 372, 1920). On *Tanacetum*, Surrey.
— **Taraxaci** Karst. **40** (IX, 41, 1887); **27** (L, 15*); **28** (III, 372); **71** (XLII, 54). On *Taraxacum*.
— **Tulasnei** Sacc. **5B**, 107*, 1899; **89**, 149*; **23** (XVII, 476); **77** (1936, 190). On *Fragaria*, stage of *Mycosphaerella Fragariae*.
— **Ulmariae** Cooke in **14** (IV, 109, 1876); Sacc. IV, 204; **40** (x, 67); **8**, 345; **70** (1936, 413); Vize Exs. 75. On *Spiraea Ulmaria*.
— **umbrosa** A. L. Smith & Ramsb. in **28** (VI, 52, 1918); Sacc. XXV, 737. On *Saxifraga umbrosa*, Scotland.
— **Urticae** Ces. **40** (VIII, 228, 1886; x, 67); **8**, 347; **7**, 336; **70** (1936, 412); **71** (XLII, 53). On *Urtica*.
— **Valerianae** (Speg.) Sacc. **40** (VIII, 228, 1886); **27** (XXXVI, 182); **28** (IV, 37); **71** (XLII, 53). On *Valeriana*.
— **vallisumbrosae** Cav. **79** (1924–38); **71** (XLII, 53); **65** (XXX, 347); **23** (XLIII, 865); **85** (XXXIX, 20); **28** (XXIII, 24*); **22** (Bull. 117). *R. Narcissi* Chittenden in **31** (3, XXXIX, 277, 1906); **56** (XXXVII, 544). As *Cercosporella Narcissi* Boud.: **84** (III, 186); **22** (Bull. 79, p. 108). On *Narcissus*.
— **variabilis** Fuckel. **14** (IV, 120, 1876); **40** (VIII, 228; x, 67); **8**, 346; **70** (1936, 414). On *Digitalis*.
— **Winteri** Thüm. **28** (III, 283, 1911; IV, 37); **70** (1936, 413). On *Ononis*.
Septocylindrium chaetospira Grove in Sacc., *Syll.* IV, 224 and in **27** (XXIV, 199*, 1886); **8**, 349. On wood, Staffs.
— **concentricum** (Berk. & Br.) Sacc. in *Syll.* IV, 225; **8**, 349; **7**, 336. *Septonema* B. & Br. in Rabenh. Fungi Eur. Exs. No. 777; **15**, 482. On chips, etc.
— **elongatisporum** (Preuss) Sacc. **8**, 349; **71** (XXVIII, 149). As *Septonema*: **19** (3, XV, 403, No. 1059, 1865); **15**, 482; **40** (IV, 347); **13**, 230; Cooke Exs. II, No. 336. On stems; recorded **40** (V, 92) as a parasite of *Geranium*.
— **leucum** Bayliss Elliott & Stansf. in **28** (VIII, 249*, 1923). On pine cones, Warwicks.
— **Magnusianum** Sacc. **40** (IX, 41, 1887); **8**, 350. On *Trientalis*, Scotland.
— **melleum** Bayliss Elliott & Stansf. in **28** (VIII, 250, 1923). On pine cones, Warwicks.

Septocylindrium pallidum Grove in Sacc., *Syll.* IV, 224 and in **27** (XXIV, 199*, 1886); **8**, 349. On *Diatrype stigma*, Worcs.
— **septatum** (Bonord.) Lindau. As *Cylindrium*: **19** (3, VII, 449, No. 954, 1861); **15**, 608*; **27** (XXII, 196). As *S. Bonordenii* Sacc.: **8**, 349*; **37** (1909, 376); **71** (XXVIII, 149). On wood, etc.
— **viride** (Corda) Sacc. **8**, 350, 1893. On wood.
Septonema irregulare Berk. & Br. in **19** (3, VII, 381*, No. 942, 1861); Sacc. IV, 399; **15**, 481; **8**, 404*; **71** (XXVIII, 149). On twigs of *Pyrus*.
— **spilomeum** Berk. in **21** (2, IV, 310*, 1845); Sacc. IV, 399; **19**, No. 466; **15**, 481*; **8**, 404; **7**, 341. On wood.
Spondylocladium atrovirens Harz. **69** (I, 352*, 1907); **37** (1909, 16*); **23** (XVI, 31 and 125); **5**, 478; **25** (XV, 517; XIX, 282); **85** (XXIX, 17); **71** (XL, 55). As *Phellomyces sclerotiophorus* Frank: **25** (III, 14, 1902); **69** (I, 161). Causes Silver-scurf of potato tubers.
— **fumosum** Mart. ex Wallr. **19** (4, VII, 431*, No. 1314, 1871); **8**, 420*; E. W. Mason, *Annotated Acc.* List II, Fasc. 1. On wood.
— **xylogenum** A. L. Smith in **28** (III, 37*, 1908); Sacc. XXII, 1384. On wood, Shropshire. 'Closely related to *S. fumosum*', E. W. Mason, loc. cit.
Stigmina Visianica Sacc. **14** (XXI, 120, 1893); **8**, 403. On leaves, Kew.

XEROSPORAE—DICTYOSPORAE

Acrospeira asperospora (Cooke & Massee) Wiltshire in **28** (XXI, 236*, 1938). *Stemphylium* Cooke & Massee in **14** (XVI, 11, 1887); Sacc. X, 672; **8**, 430*; **33** (XVI, 86). On wall-paper and on dung of wild sheep.—Saccardo and others have placed *Acrospeira* in the Amerosporae, but Wiltshire points out that it is more properly placed in the Phaeodictyae.
— **macrosporoidea** (Berk.) Wiltshire in **28** (XXI, 236*). *Epochnium* Berk. in **19** (I, 263*, No. 131, 1838); **15**, 623. *Stemphylium* Sacc. in *Syll.* IV, 519; **8**, 429; **27** (LV, 136*); **115**, 151. On old *Ribes*, etc.
— **mirabilis** Berk. & Br. in **91**, 305*, 1857 (without formal diagnosis); gen.nov. in **19** (3, VII, 449, No. 952, 1861); Sacc. IV, 282; **15**, 598*; **8**, 375*; **5B**, 435; **28** (II, 17*; XXI, 233*). On chestnuts, etc.
Alternaria Brassicae (Berk.) Sacc. in *Syll.* IV, 546; **8**, 436*; **56** (XXVII, 803); **89**, 81; **79** (III, V, IX, XI); **112**, 341; **22**, Bull. 79; **93**, 89. *Macrosporium* Berk. in **20**, 339, 1836; **15**, 577; **73** (1877, t. 26); **8**, 432. As *Polydesmus exitiosus* Kühn: **40** (IX, 172). On *Brassica*, etc. Berkeley's *Macrosporium Brassicae* evidently had long spores. Many authors have followed Saccardo, who erroneously considered that the species had smaller spores, i.e. his fungus was *Alternaria oleracea* Milbrath = *A. circinans* (Berk. & Curt.) Bolle.—See also *Cercosporella Brassicae* (p. 89).
— **Cheiranthi** (Lib. ex Fr.) Bolle. As *Macrosporium*: ?**15**, 576, 1871; **13**, 271; **8**, 434; Mason, *Annotated Acc.* List II, Fasc. 1; **28** (XVIII, 142*); Vize Exs. 138 and Fungi Brit. 173. On *Cheiranthus*. See *A. tenuis*.
— **cucumerina** (Ellis & Everh.) Elliott. As *A. Brassicae* var. *nigrescens* Pegl.: **80**, 99, 1923; **112**, 341. On *Cucumis*.
— **Dianthi** Stev. & Hall. **112**, 342; **93**, 118; perhaps **31** (3, LXXXI, 150). As *Macrosporium*: **80**, 106, 1923; **22** (Misc. Publ. 52, p. 87). On *Dianthus*.
— **Grossulariae** Jacz. **34** (VII, 190, 1920); **33** (XXXVI, 262). From spotted apples.
— **humicola** Oudem. **102** (X, 470*, 1912); **28** (IV, 183; XIX, 147); **116**, 153; **34** (XV, 95). In soil.
— **maritima** Sutherland in **32** (XV, 46*, 1915); Sacc. XXV, 866. On *Laminaria*, Orkney, Ayrshire and Dorset.
— **oleracea** Milbrath. **22** (Monthly Survey, No. 10, 1934); **112**, 341, 1928 as *A. circinans* (Berk. & Curt.) Bolle. On *Brassica* spp.
— **pomicola** Horne in **27** (LVIII, 242, 1920); **34** (VII, 190); **22**, Misc. Publ. 38. From apples.

Alternaria Solani (Ell. & Mart.) Sorauer. **61** (CXXXIV, 932*); **28** (XX, 114). As *Macrosporium*: **82** (V, 22 and 25, 1920); **34** (VIII, 13); **112**, 340; **65** (XXX, 343); **23** (XLIII, 124). On potato and tomato. See *M. Cookei*.

— **tenuis** Nees ex Wallr. **27** (L, 45, 1912); **28** (X, 113; XVIII, 135; XIX, 147); **79** (I, 18); **34** (XII, 29); **33** (XLIII, 656; XLVI, 343; XLVIII, 363); **23** (XLIII, 124); **93**, 41; Mason, *Annotated Acc.* List II, Fasc. I. 'Var. *Hordei*' recorded **69** (I, 370, 1907). As *Macrosporium commune* Rabenh.: **14** (XVI, 111, 1888); **8**, 431; **68** (1901, 615); **28** (I, 184); **34** (XVII, 290); **22** (Bull. 117, p. 145); Rabenh. Fungi Eur. No. 1360; Cooke Exs. II, No. 641. In error as *M. Cheiranthi*: **20**, 339, 1836; Cooke Exs. 197. *M. Cheiranthi* var. *Betae* Cooke in **15**, 576. As *Sporidesmium putrefaciens* Fuckel: **28** (XIV, 153); **79** (VII, 34); **22** (Bulls. 70 and 79). A common saprophyte or hemi-parasite. Various 'species' of *Alternaria* and *Macrosporium* belong to the '*A. tenuis* group.'

— **Tomato** (Cooke L. R. Jones in *Bull. Torrey Bot. Club*, XXIII, 353, 1896. *Macrosporium* Cooke in **14** (XII, 32), from S. Carolina; **14** (XVI, 112, 1888); **8**, 433; **5B**, 324*; **23** (III, XIII); **56** (XIX, 15; XXVI, 733; XXVII, 818*); **89**, 96; **66** (CXCVIIB, 7); **5**, 502; **7**, 343; **37** (1906, 242); **22** (Misc. Publs. 33 and 38); **112**, 341. On *Lycopersicum*. *A. Tomato* causes 'Nailhead Spot' in America; see Florida Bull. 332. Most or all the British records refer to saprophytic species, such as those associated with Blossom-end Rot. Massee regarded *M. Tomato*, *M. Lycopersici* Plowr. and *Cladosporium Lycopersici* Plowr. as synonyms of *M. Solani* Cooke (see *M. Cookei*).

— **Violae** Galloway & Dorsett. **56** (XXVI, 492, 1901; XXVII, 27*); **89**, 28. On *Viola*.

Coniothecium amentacearum Corda. **19** (2, V, 460, No. 460, 1850); **66** (1857, 548); **45** (XXIV, 159*); **15**, 827; **8**, 427; Cooke Exs. 531 and II, No. 26. On willow branches.

— **betulinum** Corda. **19**, No. 461, 1850; **15**, 820; **8**, 427; Cooke Exs. 622 and II, No. 25. On birch.

— **chomatosporum** Corda. **37** (1915, 104*); **22** (Misc. Publs. 33, 38, 52, 70, 79); **112**, 340; **65** (XXX, 338); **77** (1928–30, II, 150). On *Pyrus Malus*. Massee, **37**, thought this fungus and *Phoma Mali* Schulz & Sacc. were stages of *Diaporthe ambigua* Nits. Van der Bijl, *S. Afr. J. Sci.* XII, 649, 1915 obtained *Phoma Mali* from pure cultures of the *Coniothecium*.

— **chomatosporum** var. **variegatum** Preuss. **27** (XXVI, 201, 1886). On wood, Worcs.

— **complanatum** (Nees ex Fr.) Sacc. **28** (XXII, 4, 1938). On *Salix*, Surrey.

— **conglutinatum** Corda. **40** (IX, 40, 1887); **8**, 427; **7**, 343. On birch wood, etc.

— **effusum** Corda. **19**, No. 459, 1850; **8**, 427; **7**, 343; **71** (XXVIII, 149). *Sporidesmium Lepraria* Berk. in **21** (1853, 43*); **19**, No. 750; **15**, 484; **13**, 231; Cooke Exs. 532 and II, No. 631; Vize Exs. 24. As *Lepraria nigra* Turn. & Borr., Sowerby's *Engl. Bot.* t. 2409. On wood.

— **epidermidis** Corda. **70** (1936, 417). On *Cytisus*, Ireland.

— **sphaerale** (Fr.) Keissler. **119**, 616; **28** (V, 433, 1917) as *Sclerococcum*. On lichens, Scotland and Wales.

— **viticola** Cooke & Massee in **14** (XVI, 9, 1887); Sacc. X, 669; **8**, 428*; **7**, 343. On dead *Vitis*.

Dactylosporium brevipes Grove in **27** (XXIV, 205*, 1886); Sacc. X, 678; **8**, 436*. On sycamore wood near Birmingham.

Dictyosporium Boydii A. L. Smith & Ramsb. in **28** (V, 168, 1915); Sacc. XXV, 844. On wood, Scotland.

— **elegans** Corda. **19** (2, V, 460, No. 458, 1850); **15**, 486*; **46** (III, 65); **8**, 428*; **37** (1911, 377). On wood, etc.

— **toruloides** (Corda) Guéguen. As *Speira*: **19** (3, XV, 401, No. 1041, 1865); **15**, 479*; **13**, 230; **8**, 429*; **71** (2, VI, 27). On herbs and wood. Guéguen **117** (XXI, 98) considered *Speira* and *Dictyosporium* congeneric. Chenantais **117** (XXXV, 203) agreed, and gave several synonyms for *D. toruloides*, including *D. elegans* and *Hormiscium hysterioides*. See *Speira* below.

Epicoccum diversisporum Preuss. **14** (xv, 43, 1886); **8**, 488; **7**, 350. On reeds, etc.—Saccardo and others have placed *Epicoccum* in the Amerosporae, but the spores become muriform.
— **Equiseti** (Berk.) Berk. in **18**, 341, 1860; **15**, 560; **8**, 488; **7**, 350. *Uredo* Berk. in **20**, 384, 1836; **19**, No. 500. On old *Equisetum*.
— **granulatum** Penzig. **27** (xxiii, 169, 1885); **8**, 487; **28** (xix, 147); **67** (cxvii B, 154). On grasses, etc.
— **herbarum** Corda. **14** (xvii, 16, 1888); **8**, 488; **7**, 350. On leaves, etc.
— **maritimum** Sutherland in **32** (xv, 47*, 1916); Sacc. xxv, 985. On *Laminaria*, Orkney and Dorset.
— **micropus** Corda. **19** (4, vii, 431, No. 1313, 1871); **8**, 488; **7**, 350. On *Lactarius*.
— **neglectum** Desm. **19** (2, v, 466, No. 500, 1850); **15**, 560*; **13**, 267; **8**, 488; **46** (iii, 136); **7**, 350; **71** (xl, 55); Cooke Exs. ii, No. 171. On old plants.
— **purpurascens** Ehrenb. ex Wallr. **27** (xxii, 200, 1884); **8**, 489*; **7**, 350; **71** (xxviii, 150); **62** (xxii, 434); **116**, 155. As *E. vulgare* Corda; **8**, 487; **7**, 350. On stems, etc.
Fumago vagans Pers ex Sacc.? **14** (xvi, 112, 1888); **8**, 437*; **89**, 162* and 216; **35** (1920, 403); **71** (xxviii, 150). On leaves.
Macrosporium Camelliae Cooke & Massee in **14** (xvii, 42, 1888); Sacc. x, 674; **89**, 165. On *Camellia*.—Wiltshire **28** (xviii, 135) points out that *Macrosporium* and *Alternaria* are congeneric, and concludes that *Macrosporium* should be considered a *nomen ambiguum*. The species of *Macrosporium* included here, most of which are doubtful, have apparently not been transferred to *Alternaria*.
— **cladosporioides** Desm. **14** (iii, 66, 1874); **8**, 431; **102** (x, 470); Vize Exs. 137; Cooke Exs. 620 and ii, No. 161. On leaves and stems.
— **concinnum** Berk. in **19** (1, vi, 435*, No. 235, 1841); Sacc. iv, 531; **15**, 577*; **13**, 272; **8**, 432; **46** (iii, 65). On willow twigs, etc.
— **Convallariae** Fr. **14** (xvi, 112, 1888); **8**, 434. On *Convallaria*.
— **Cookei** Sacc. in *Syll.* iv, 530; **31** (1905, 230); **89**, 95. *M. Solani* Cooke [non Ell. & Mart.] in **14** (xii, 32, 1883), described from S. Carolina; **23** (i, 206, 1894; xii–xv); **56** (xix, p. cxxxvi); **5B**; **37** (1906, 112 and 242; 1914, 145); **5**, 502*; **56** (xxxvi, 620; xxxix, 595); **112**, 340. On potato, probably a saprophyte. It was thought to cause leaf-curl. Massee considered *M. Tomato* to be a synonym.
— **heteronemum** Desm. **27** (iv, 116, 1866); **15**, 577; **8**, 432. On old *Sagittaria*.
— **ignobile** Karst. **28** (iv, 183, 1913). On *Arum*, Ayrshire.
— **laminarianum** Sutherland in **32** (xv, 45*, 1916); Sacc. xxv, 862. On *Laminaria*, Dorset and Orkney.
— **Lycopersici** Plowr. in **31** (2, xvi, 621*, 1881); Sacc. x, 676. On *Lycopersicum*. See *Alternaria Tomato*.
— **nobile** Vize apud Cooke in **14** (v, 119, 1877); Sacc. iv, 529; **73** (1877, t. 26); **8**, 432*; **5B**; **56** (xxvi, 650*); **89**, 36*; **5**, 503*; Vize Exs. 63. On *Dianthus*.
— **Pelvetiae** Sutherland in **32** (xiv, 42*, 1915); Sacc. xxv, 862. On *Pelvetia*, said to be a stage of *Pleospora Pelvetiae*.
— **ramulosum** Sacc. **14** (xvi, 111, 1888); **8**, 433. On Umbelliferae.
— **Saponariae** Peck. **70** (1936, 417). On *Saponaria*, Ireland.
— **Scolopendrii** Cooke in **14** (xvi, 81, 1888); Sacc. x, 677; **73** (1877, t. 26); **8**, 434. On *Scolopendrium*, Irstead.
Mystrosporium adustum Massee in **31** (3, xxv, 412*, 1899); **5B**, 325; **56** (xxvii, 398*); **89**, 75*; **23** (xv, 509); **5**, 505; **79** (iv–xi); **22** (Misc. Publ. 70, Bull. 79 and Bull. 117 with literature); **31** (3, lxxxix, 55); **56** (lxi, 157*); **85** (xxxvii, 19). On bulbs of *Iris*.
— **Stemphylium** Corda. **19** (3, vii, 382, No. 949, 1861); **15**, 578, the figure an error, see **73** (1877, 12); **8**, 434*; **71** (xxviii, 149). On wood and stems.
Sarcinella Questieri (Desm.) von Höhnel. As *Coniothecium*: **28** (ii, 15, 1903); **56** (xxvii, p. cxcviii); **89**, 110. On apple leaves; the bulbil stage of *Schiffnerula pulchra*.

Septosporium atrum Corda. **14** (xvi, 112, 1888); **8**, 435. On old *Smyrnium*.
— **bulbotrichum** Corda. **15**, 579*, 1871; **48** (ii, 259); **8**, 435*. On wood.
— **elatius** Grove in **27** (l, 45*, 1912); Sacc. xxv, 863. On bark, Wales.
Speira cohaerans Preuss. Grove **27** (l, 45, 1912) renamed it *S. toruloides* var. *translucens* Grove. On bark, Warwicks. See *Dictyosporium* above.
— **effusa** (Peck) Sacc. **27** (l, 45, 1912). On wood, Studley Castle. Grove decided that it is a variety of *S. toruloides*.
Sporodesmium antiquum Corda. **14** (xvi, 110, 1888); **8**, 425. On wood.—Early mycologists usually used the spelling 'Sporidesmium'.
— **antiquum** var. **compactum** Berk. & Br. in **19** (2, v, 459, No. 453, 1850); Sacc. iv, 500; **15**, 484; **8**, 425. On wood.
— **chartarum** Berk. & Curt. **14** (xvi, 110, 1888); **8**, 426; **37** (1911, 377); **35** (1913, 175); Cooke Exs. 329. On paper, etc.
— **Cladosporii** Corda. **14** (iii, 65, 1874); **8**, 426; Cooke Exs. 679. On stems, etc. Corda thought it a parasite of *Cladosporium*.
— **lobatum** Berk. & Br. in **19** (3, xviii, 121*, No. 1146, 1866); Sacc. iv, 499; **15**, 485*. On 'fir sticks, Lucknam.'
— **melanopum** (Ach.) Berk. & Br. in **19** (2, v, 459, No. 455, 1850); Sacc. iv, 498; **15**, 484; **8**, 425. As *Spiloma*: *Engl. Bot.* t. 2358. On bark. Saccardo mis-spelled the epithet as 'melanopodum'.
— **myrianum** Desm. **27** (lx, 176*, 1922); **102** (xxxii, 109). On *Ammophila*. Grove considered *Spegazzinia Ammophila* Rostr. to be the same.
— **polymorphum** Corda. **19**, No. 452, 1850; **15**, 483*; **8**, 426. On wood.
— **putrefaciens** Fuckel. As *Clasterosporium*: **25** (xxvii, 22). Other references under *Alternaria tenuis*. On *Beta*.
— **scutellare** Berk. & Br. in **19** (2, v, 459, No. 456, 1850); Sacc. iv, 499; **15**, 484; **8**, 425. On larch bark, Essex.
— **Solani-varians** Vanha. **23** (xvi, 646, 1909); **5**, 499; **71** (xxviii, 149). On potato leaves. A doubtful species.
— **Triglochinis** Berk. & Br. in **19** (4, xvii, 141*, No. 1607, 1876); Sacc. iv, 506; **14** (v, 57); **13**, 231; **8**, 426. On *Triglochin*, Scotland.
Stemphyliopsis heterospora A. L. Smith gen.nov. in **68** (1901, 617); **28** (i, 194*); Sacc. xviii, 561. On germinating seeds, Norwood. Doubtless an albino mutant of a species of *Stemphylium*.
Stemphylium Alternariae (Cooke) Sacc. in *Syll.* iv, 523; **8**, 430; **7**, 343. *Sporidesmium* Cooke in **15**, 483, 1871; **13**, 231; Cooke Exs. 329 as *S. polymorphum* var. *chartarum*. On wall paper.—See Wiltshire **28** (xxi, 211) on *Stemphylium*.
— **Berlesii** Oudem. **28** (xix, 147, 1935). From the air.
— **botryosum** Wallr. **102** (x, 470); **28** (iv, 183); **116**, 151; **70** (1929, 314); **28** (xxi, 212*) with some synonymy. *Mystrosporium Alliorum* Berk. in **31** (1878, 192); Sacc. iv, 541; **19**, No. 1982; **14** (xi, 15); **8**, 435; **5B**, 441; **5**, 505. *Macrosporium Sarcinula* Berk. in **19** (i, 261*, No. 125, 1838); Sacc. iv, 524; **15**, 576; **40** (viii, 228); **8**, 431; **37** (1906, 195); Mason, *Annotated Acc.* List ii, Fasc. 1; **28** (xiv, 225); **22**, Bull. 79; **31** (3, lxxxix, 35); **85** (xxxiii, 19). *M. Alliorum* Cooke & Massee in **14** (xvi, 80, 1888); **8**, 433. As *M. parasiticum* Thüm.: **33** (iii, 268, 1889); **22** (Misc. Publs. 23, 33, 38 and 70); **23** (xxvi, 170); **65** (xxx, 332). As '*M. commune* Rabenh.': **28** (x, 101); Cooke Exs. 641. On various plants; a stage of *Pleospora herbarum*.
— **ericoctonum** Braun & de Bary. **70** (xix, 561*, 1930); **33** (clxxxii, 343*); **24** (xx, 365). Reported in butter and on heather.
[— **fuscum** Currey apud Cooke, nomen nudum, **14** (xvi, 111).]
— **graminis** (Corda) Bon. **28** (x, 112, 1924); **116**, 151. In apples, etc.
— **Magnusianum** Sacc. **27** (xxiv, 205, 1886); **8**, 430. On bark, etc.
— **paxianum** (von Szabo) Lindau. *J. Oil Col. Chem. Ass.* xxii, 184, 1939. From rain-water, Sheffield. Doubtful; see **28** (xxi, 231).
— **piriforme** (Corda) Bon. **28** (iv, 328); **116**, 152. As *Sporidesmium*: **19**, No. 454, 1850; **15**, 484; **8**, 426; **33** (xvi, 85*); **7**, 343. On wood, etc.
— **sarciniforme** (Cav.) Wiltshire in **28** (xxi, 228*, 1939). On clover, Hants.

Tetraploa aristata Berk. & Br. gen.nov. in **19** (2, v, 459*, No. 457, 1850); Sacc. iv, 516; **15**, 487*; **40** (viii, 189); **46** (v, 50); **8**, 429*; **71** (2, iv, 27); **28** (viii, 254). On grasses.

XEROSPORAE—HELICOSPORAE

Helicodendron tubulosum (Riess) Linder. As *Helicomyces*: **14** (iii, 178*, 1875); **8**, 351*; **7**, 336. On wood.—See Linder **101** (xvi, 227–388, 1929) for descriptions and figures of this and other Helicosporae.
Helicoma candidum (Preuss) Linder. Recorded (as *Helicomyces*) **115**, 98, 1937, Yorks.
— **Muelleri** Corda. **19** (2, vii, 98, No. 510, 1851); **15**, 580*; **13**, 272; **101** (xvi, 307); **73** (1877, t. 27); Vize Exs. 62. As *Helicosporium*: **8**, 439*; **7**, 343. As *Helicocoryne viridis* Corda: **19**, No. 951; **15**, 581*. As *Helicosporium viride* (Corda) Sacc.: **8**, 439; **28** (viii, 7); Cooke Exs. ii, No. 447; Vize Exs. 62. On bark and wood.
— **phaeosporum** Fres. *Helicosporium Boydii* A. L. Smith & Ramsb. in **28** (v, 168, 1915); **101** (xvi, 304*). On wood, Scotland.
Helicomyces roseus Link ex Fr. **19**, No. 1386, 1873 (name only); **68A** (1877, 195); **27** (xxii, 197); **8**, 351; **28** (i, 66); **71** (xxviii, 149); **101** (xvi, 271). On wood.
— **scandens** Morgan. **28** (ii, 60, 1904). On wood, Savernake.
[**Helicoon ellipticum** (Peck) Morgan. *Helicosporium ramosum* (Berk. & Smith) Massee in **8**, 440*, 1893; apparently included in error, for the species is American. There is no British specimen in the Kew Herbarium.]
Helicosporium albidum Grove in **27** (xxiv, 204*, 1886); Sacc. x, 681. On *Rubus*, Warwicks.
— **lumbricoides** Sacc. **27** (xxiv, 204, 1886); **8**, 440. On oak, Sutton.
— **pulvinatum** Nees ex Fr. **18**, 326, 1860; **8**, 439; **71** (xl, 55). Var. *effusum* Berk. in **20**, 335, 1836; Sacc. iv, 557; **15**, 480. On wood. Species imperfectly known.
[— **Renneyi** nomen nudum in **14** (xvi, 113). The specimen is poor *Helicomyces roseus*.]
— **vegetum** Nees ex Fr. **120**, 557, 1821; **19** (1, vi, 434, No. 229, 1841); **15**, 480*; **73** (1877, t. 26); **8**, 440; **101** (xvi, 278). On oak.

XEROSPORAE—STAUROSPORAE

Ceratosporium digitatum (Cooke) Sacc. in *Syll.* iv, 553; **8**, 438*; *Sporidesmium* Cooke in **14** (viii, 8, 1879). On holly branches, Norfolk.
Prismaria furcata Grove in **27** (xxii, 198*, 1884); Sacc. iv, 230; **8**, 351. On wood, Sutton.
Tetracladium Marchalianum De Wild. **28** (xvii, 82, 1932). In fresh water, London. See **100** (xxvii, 478, 1935).
Tridentaria setigera Grove in **27** (l, 16*, 1912); Sacc. xxv, 750; **28** (iii, 373). On a stem, Worcs.
Trinacrium subtile Riess. **27** (l, 15, 1912). On *Peniophora*, Hereford.
Triposporium Boydii A. L. Smith & Ramsb. in **28** (v, 168, 1915); Sacc. xxv, 867. On wood, Scotland.
— **elegans** Corda. **19** (2, vii, 98, No. 509, 1851; fig. with No. 1053); **15**, 580*; **73** (ii, 1871, t. 8); **13**, 272; **8**, 438*; **35** (1907, 253); Cooke Exs. 554. On wood.
— **ficinusium** Preuss. **14** (xvi, 112, 1888); **8**, 438. On branches, Bexley.

MYCELIA STERILIA (See p. 52)

Anthina flammea Fr. **20**, 329, 1836; **19**, No. 119; **18**, 338*; **15**, 549*; **13**, 264; Berk. Exs. 206. *Clavaria miniata* Purton in **55** (iii, 267*). On wood, etc.
Coccobotrys xylophilus (Fr.) Boud. & Pat. Ramsbottom, *Handbook Larger British Fungi*, p. 29, 1923. On mycelium of *Lepiota meleagris* Quél.
Ectostroma Iridis Fr. **28** (xx, 12, 1935). On *Iris*, Norfolk.

Ozonium auricomum Link ex Wallr. **39**, t. 260, 1827; **51**, 470, and several early records as *Byssus* spp. Mycelium of *Coprinus domesticus*.

Papulaspora byssina Hotson. **31** (3, xcvi, 463*, 1934); **79** (xii, 32); **85** (xxxv, 27; xxxix, 23; xli, 17). In mushroom beds; said to be *Myriococcum praecox* Fr., a dubious Ascomycete.

— **sepedonioides** Preuss. **19** (2, xiii, 462, No. 761, 1854); **15**, 618*; **8**, 293*; **28** (i, 66); **71** (xxviii, 148). On decaying substances.

Rhacodium cellare Pers. ex Wallr. **120**, 558; **92** (ii, 34); **51**, 470; **39**, t. 259; **58** (ii, 212); **20**, 324; **66** (ccxxb, 99). As *Zasmidium*: **18**, 407; **15**, 628*; **13**, 289; Cooke Exs. 467 and ii, No. 644; Vize Exs. 81. *Fibrillaria vinaria* Sow. in **42**, t. 432, 1815. On casks, etc. Schanderl transferred it to *Cladosporium* in *Centralbl. Bakt.* 2, xciv, 117, 1936; see also **28** (ix, 94).

Rhizoctonia Allii Graves ex Fr. **23** (ii, 437, 1896). On *Allium*.

— **Crocorum** DC. ex Fr. **56** (v, 23, 1850); **89**, 73; **85** (1908, 1928–33); **24** (ii, 482); **64** (xlii, 58); **65** (xxx, 342); **104** (xv, 81); **112**, 352, etc. As *R. violacea* Tul.: **23** (ii, 437, 1896); **28** (ii, 33); **23**; **78**, etc. On *Asparagus* and other hosts; stage of *Helicobasidium purpureum* (Tul.) Pat., **28** (xii, 116).

[— **Menthae** B. & Br. in **19**, No. 985, 1861 is a *Tuberculina*; see **28** (xii, 137).]

[— **Monteithianum** Bennett, nomen nudum in **31** (3, xcvii, 129). On turf.]

— **Solani** Kühn. Many records on various hosts, e.g. **23** (i, 58, 1894) to date; **56**, **24**, **85**, etc.; stage of *Corticium Solani*.

Sclerotium bullatum DC. ex Fr. **51**, 462, 1824; **20**, 224. On gourds.

— **cepivorum** Berk. in **19** (i, vi, 359, No. 168, 1841); Sacc. xiv, 1151; **71** (i, ii, v, xi); **23** (xxxiv, 49; xxxiii, 19); **56** (liii, 51); **93**. Berk. Exs. 276 as '*S. Cepae*'. Records of *Sclerotinia bulborum* (Wakker) Rehm on onions, e.g. **23** (xiv, 358; xxiii, 1095; xxvi, 177); **77** (1924, 111) probably are *Sclerotium cepivorum*; see **22**, Bull. 117. On *Allium*.

— **clavus** DC. is the sclerotium of *Claviceps purpurea*.

— **complanatum** Tode ex Fr. **20**, 221, 1836; Berk. Exs. 72. Sclerotium of *Typhula*.

— **Delphinii** Welch. **22**, Bulls. 79 and 117. On imported bulbs.

— **fungorum** Pers. ex Fr. **20**, 223, 1836; Ramsbottom, *Handbook*, p. 47. Sclerotia of *Collybia tuberosa*.

— **giganteum** Rostr. Ramsbottom, *Handbook*, p. 127. Sclerotia of *Polyporus umbellatus* Fr.

— **Gladioli** Massey. **22** (Misc. Publ. 70, p. 68; Bull. 117); **112**, 355; **79** (v–vii, xi); **65** (xxx, 346); **71** (xl, 55). On *Gladiolus*. The perfect stage is *Sclerotinia Gladioli*.

[— **Hyacinthi** Guepin. **40** (x, 68, 1889). On dead scopes of *Scilla nutans*. Possibly sclerotia of *Botrytis cinerea*.]

— **lacunosum** Pers. ex Fr. **42**, t. 287, 1800; Ramsbottom, *Handbook*, p. 47. Sclerotia of *Collybia racemosa*.

— **medullare** Berk. in **19** (i, 47*, No. 14, 1837); Berk. Exs. 75. Inside stems of *Pteridium*, Northants. The name is a later homonym of *S. medullare* Schwein.

— **muscorum** Pers. ex Fr. **58** (ii, 138); **20**, 223. As *S. subterraneum* Tode: **39**, t. 101, 1824; **51**, 461. Amongst mosses.

— **mycetospora** Nees ex Fr. Ramsbottom, *Handbook*, p. 30. Sclerotia of *Lepiota cepaestipes*.

— **neglectum** Berk. in **19** (i, 205, No. 91, 1838); Berk. Exs. 165. On leaves.

— **nervale** Fr. **40** (x, 68, 1889). On leaves.

— **populinum** Pers. ex Fr. **51**, 463, 1824; **20**, 225. On poplar leaves.

— **pustula** DC. ex Fr. **58** (ii, 137); **20**, 225. As *S. quercinum* Pers.: **120**, 591, 1821; **39**, t. 77; **51**, 462. On leaves of oak (stage of *Sclerotinia Candolleana*) and of poplar.

— **pyrinum** Fr. **20**, 224; Berk. Exs. 166. *S. fructuum* Grev. in **51**, 462, 1824. On fruits.

— **quercigenum** Berk. in **20**, 222, 1836; Sacc. xiv, 1148. On felled oaks.

— **rhizodes** Auersw. **28** (xvi, 308, 1922); **22**, Bull. 79. On *Agrostis*.

[— **Rolfsii** Sacc. **112**, 354, 1928. On imported corms of *Arum*.]

Sclerotium roseum Moug. ex Fr. **19** (I, VI, 359, No. 163, 1841); **40** (X, 68); **28** (XXII, 11). In *Juncus*; stage of *Sclerotinia Curreyana.*
— **Rubi** Carm. ex Berk. in **20**, 224, 1836. On leaves of *Rubus.*
— **salicinum** DC. ex Fr. **51**, 462, 1824; **20**, 225; Berk. Exs. 28. On willow leaves.
— **scutellatum** Alb. & Schw. ex Fr. **39**, t. 144, 1823; **20**, 222; Ramsbottom, *Handbook*, p. 154; Berk. Exs. 27. On leaves; sclerotia of *Typhula phacorrhiza.*
— **semen** Tode ex Fr. **39**, t. 144; **20**, 222; **58** (II, 137); Berk. Exs. 73. *Sphaeria Brassicae* Bolton in **111**, t. 119, 1789; **42**, t. 393. On stems.
— **stellatum** Horne in **27** (LVIII, 242, 1920). Isolated from apples.
— **truncorum** Fr. **19** (I, 571, No. 53, 1837); Ramsbottom, *Handbook*, p. 47. Sclerotia of *Collybia cirrhata.*
— **Tuliparum** Kleb. *Cornell Agr. Exp. Sta. Mem.* 89, 1925; **31** (3, LXXIX, 271); **23** (XXXIII, 624; XLIII, 702; XLIV, 54); **56** (LIII, 51); **112**, 353; **79** (XIII, 34); **22**, Bulls. 79 and 117. As *Rhizoctonia*: **65** (XXX, 348); **71** (XL, 55). On *Tulipa*, etc.
— **varium** Pers. ex Fr. **20**, 223, 1836. On stored vegetables; sclerotia of *Sclerotinia sclerotiorum.*
Xylostroma giganteum Tode ex Sacc.? **42**, t. 358, 1802; Ramsbottom, *Handbook*, p. 129. Sheets of mycelium of *Polyporus betulinus.*

DOUBTFUL AND EXCLUDED GENERA

Excluded species in accepted genera are indicated above by square brackets. Both the genera and species below are doubtful or excluded Hyphomycetes.

Acalyptospora nervisequia Desm. **19**, No. 1043; **15**, 488*. Glandular hairs; see **14** (I, 43).
Alliospora Sapucayae Pim gen.nov. in **27** (XXI, 234, 1883) and in **71** (2, IV, 27, 1883); **28** (I, 66). On *Sapucaya* nut, Ireland. This was apparently an *Aspergillus.*
Asterophora agaricicola Corda. **8**, 326*, etc. Chlamydospores of *Nyctalis asterophora.*
Blastotrichum puccinioides Preuss = *Mycogone puccinioides* (Preuss) Sacc. A 'chlamydosporous' state of *Hypomyces ochraceus* (see **28** (XXI, 273*)); the conidial state is entered above as *Verticillium agaricinum.* The spores of *Blastotrichum* are aleuriospores, and some will consider this state 'higher' than the *Verticillium.*
Bolacotricha grisea Berk. & Br. gen.nov. in **19** (2, VII, 97*, No. 506, 1851). A *Chaetomium*: see **28** (XXIV, 133).
Cephalotrichum curtum Berk. in **19** (1, VI, 432*, No. 222, 1841); Sacc. IV, 275; **15**, 569*; **8**, 371*. Von Höhnel, *Centralbl. Bakt.* 2, LX, 9, 1924, claimed that the type is a *Haplographium.*
Epidochium atrovirens (Fr.) Fr. **14** (XVII, 16, 1888); **8**, 489*. On branches. This is *Tremella atrovirens* (Fr.) Sacc.
— **Xylariae** von Höhnel. **35** (1936, 275). On *Xylaria*, Yorks.
Fusicolla Betae Bon. **14** (XVII, 13, 1888). On beet-root. Probably *Fusarium* sp.
Fusoma tenue Grove in **27** (L, 16*, 1912). On a stem, Worcs. Placed in *Die Fusarien* as a synonym of *Fusarium culmorum.*
— **triseptatum** Sacc. Listed **71** (XLII, 53, 1931). According to Wollenweber, perhaps a *Septogloeum.*
Himantia candida Pers ex Chev. **39**, t. 228, 1823; **92** (II, 35); **51**, 470; **58** (II, 213). *Fibrillaria stellata* Sow. in **42**, t. 387, 1803. The mycelium of Hymenomycetes.
Microstroma album (Desm.) Sacc. **8**, 276*; **89**, 207*. As *Fusisporium*: **19** (1, VI, 438, No. 248, 1841); Berk. Exs. 321. As *Fusidium*: **15**, 609; **13**, 283; Vize Exs. 141. On oak leaves. *Microstroma* is probably not a Hyphomycete.

Milowia amethystina Massee in **37** (1907, 243*). On wood, Kew. *Milowia* Massee was based on *Thielaviopsis basicola.*

Mycelium radicis nigrostrigosum Hatch and similar names are used for mycorrhizal fungi, e.g. **76** (VIII, IX), *J. Ecol.* IX, 254, 1922.

Myxotrichum spp. were formerly considered Hyphomycetes, e.g. by Massee **8.** British records are included in the Pyrenomycetes.

Oedemium atrum Corda ex Fr. An uncertain fungus recorded **19**, No. 501; **15**, 569*; **8**, 376*, etc. On wood.

Pachnocybe ferruginea (Sow. ex Fr.) Berk. in **20**, 334, 1836; *Mucor* Sow. in **42**, t. 378. On worked wood. Specimens agreeing with Berkeley's were recently found on boards in a dwelling, England. *Pachnocybe* Berk. is uncertain; the first of the five species is *Graphium subulatum.*

Paepalopsis Irmischiae Kühn. **28** (v, 290). In flowers of *Primula*, Kent; said to be conidia of *Tuburcinia primulicola.*

Pericystis alvei Betts in **27** (XXVI, 798*, 1912). In beehives. This may be a Phycomycete.

Periola tomentosa Fr. **18**, 342 and 356; **15**, 622; **8**, 472*. British records, at least, apparently based on specimens of *Fusarium.*

Psilonia densa Berk. in **20**, 353, 1836. On rotten potatoes, Northants.

— **nivea** Fr. is of insect origin: see **19**, No. 1319; **8**, 474.

Rhizomorpha spp. were listed by early mycologists, and included *R. divergens* Grev., *R. farinacea* Grev., *R. medullaris* J. S. Smith, *R. subterranea* Pers., and *R. subcorticalis* Pers. The last two names refer to the rhizomorphs of *Armillaria mellea.*

Sphaeridium vitellinum Fres. **40** (x, 282, 1890). On beech leaves, Scotland.

HOST INDEX

Only vascular plants and the cultivated mushroom are included. Saprophytes and doubtful parasites are usually omitted. No effort is made to give the full host range of plurivorous parasites such as *Fusarium, Botrytis, Verticillium, Sclerotium,* etc.

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INDEX TO GENERA AND SPECIES OF HYPHOMYCETES

A numeral in italics refers to a name entered as a synonym or otherwise not accepted. The authors for genera are given here, for species in preceding pages. Pre-Friesian authorities are accepted for synonyms (e.g. *Dematium griseum* Pers., *Polyactis* Link). In ordinary citations of accepted genera and species the pre-Friesian authorities may be omitted, e.g. '*Polythrincium* Fr.' in place of '*Polythrincium* Kunze & Schm. ex Fr.'; 'apud' and 'in' and the author following may also be omitted, e.g. we cite '*Macrosporium nobile* Vize apud Cooke' so as to continue with the place of publication; the fungus is *M. nobile* Vize.

A specific epithet is entered but once, under the generic name here accepted, i.e. nomenclatural synonyms are not included. Thus if one wishes to look up '*aureus, Aspergillus*' he may not recognize it in this Index; but he may assume that it can be traced as 'aurea', 'aureum' or 'aureus', and will find it as *Nematogonium aureum.*

Hyphomycetes only are included here. The names of perfect stages mentioned will be indexed at the end of the volume.

ADDENDUM TO MYCELIA STERILIA

Cenococcum geophilum Fr. **20**, 307; **18**, 304; **15**, 376. *Lycoperdon graniforme* Sow. in **42**, t. 270, 1800. In humus. See ref. in *Rev. Appl. Myc.* v, 316.

(*Accepted for publication* 27 *November* 1940)

BRITISH SPECIES OF *HYSTERIUM*, *GLONIOPSIS*, *DICHAENA* AND *MYTILIDION*

By G. R. BISBY

(With Plate V and 1 Text-figure)

LITTLE critical study has been given to the Hysteriales of Britain. A list of the species recorded, with references, is given by Bisby and Mason (1940).

European workers, up to a century ago, tried to differentiate species on the appearance of the hysterothecia and by their hosts. Later it became evident that spore-characters provide the main criteria for separating species and even genera. Mycologists then found themselves with a number of early descriptions without microscopic details and often unsupported by authentic specimens. They tried to fit their collections to existing names with little regard for any 'type specimens' extant. Every now and then a 'new species' was proposed for some new collection. Thus the taxonomy has become increasingly confused, and little is known either of the variation of the European species, or of their development in culture.

HYSTERIUM [Tode] Fr. emend. Sacc.

Two species of *Hysterium* have been recorded in Britain.

(I) *H. pulicare* Pers. ex Fr. occurs on bark and wood of broad-leaved trees, especially *Betula*. The ascospores are 18–35 × 6–10 μ. The specimens here described are about average for the species. They were on rough, black areas on bark of living *Betula*, Surrey, 9 Jan. 1938.

Hysterothecia scattered or gregarious, inconspicuous, superficial or nearly so, 0·4–1 mm. long, 0·3–0·4 mm. wide, about 0·3 mm. high, dull black, marked with an indistinct line or two each side of and parallel with the central cleft; the cleft gradually widens to expose the hymenium, which is coloured dark brown by the tips of the paraphyses; asci clavate, 8-spored, 1–3-seriate, about 100 μ long, spore-bearing part 50–80 × 15–20 μ; ascospores 21–26 × 6–8 μ, 3-septate, the two central cells olive-brown and larger than the end cells (e.g. a spore 26 μ long has central cells each about 8 μ and end cells each about 5 μ long); both end cells paler in about 80 per cent of the spores, only one end cell paler in about 10 per cent, and all four cells brown in 10 per cent.

Ascospores were discharged upon agar, and monosporous and polysporous cultures were readily obtained and transferred to various media. Quaker-oat agar was as good as any medium used.

Practically every discharged ascospore promptly germinated, first from both end cells, then usually also from one or both central cells. The mycelium grew slowly (colonies on agar 8–10 mm. in diameter after five weeks at room temperature), remained white for about a fortnight, then gradually darkened to olivaceous.

Pycnidia began to appear in about six weeks, and others continued to appear for several weeks thereafter. Beads of exuded spores were first whitish, then amber-coloured. The pycnidia were oval, $120–150 \times 100–120\mu$, with an ostiole about $45 \times 15\mu$; wall membranous, mycelioid-pseudoparenchymatous; conidiophores slender; conidia $3–5 \times 1{\cdot}5\mu$, hyaline, eguttulate or sometimes biguttulate.

No hysterothecia developed in cultures kept for eleven months.

Lohman (1933*a*) obtained the same pycnidial stage in cultures of *H. pulicare*, described and figured it, and saw germinating conidia. It can be referred to *Hysteropycnis* (see below).

(II) *Hysterium angustatum* (Alb. & Schw. ex Fr.) Chev. was considered by Fries (1828), Duby (1861) and others to be a variety of *H. pulicare*. British mycologists have always treated *H. angustatum* as a distinct species, as most modern mycologists do, but Hilitzer (1929) placed it as a form of *H. pulicare*.

The spores of *H. angustatum* are shorter than in most collections of *H. pulicare*, being $15–23\ (25) \times 5–7\mu$, and all their cells are brown. *H. angustatum* seems to occur more commonly on bare wood, and *H. pulicare* on bark, of broad-leaved woody plants.

Specimens on a fallen, decorticated branch of *Fraxinus*, Dorset, 9 June 1938 differed from those of *H. pulicare* described above as follows: the hysterothecia were more flexuous and usually narrower, particularly at the ends; the spores were $15–19 \times 5–7\mu$, often somewhat curved, and their end cells were little or no paler than the central. I considered this to be *H. angustatum* with spores rather shorter than usual.

The ascospores germinated as did those of *H. pulicare* and produced similar cultures and pycnidia. The conidia were smaller, $2–3 \times 0{\cdot}5–1\mu$. This pycnidial stage agrees with *Hysteropycnis occulta* Hilitzer (1929), which he described as associated with *Hysterium pulicare* (called *H. alneum*); but, since he did not distinguish *H. angustatum* as distinct, Hilitzer's pycnidia may have belonged to the latter.

So far, so good; the two species seemed distinct in both perfect and imperfect states until Dr C. G. C. Chesters forwarded me a collection on a decorticated branch of *Fagus*, Ludlow, 7 April 1938. The hysterothecia were similar to those described above for *H. pulicare*; pycnidia associated on the branch had conidia $3–5 \times 1{\cdot}5\mu$, like those

of *H. pulicare*; but the ascospores were those of *H. angustatum*, i.e. 18–23 × 6–7·5 μ, with end cells little or no paler than the central cells. Cultures were made but no pycnidia were found. Lohman (1933 *a*) also obtained no pycnidia or spores from his specimens intermediate between *H. pulicare* and *H. angustatum*.

But after examining many specimens, I still distinguish *H. angustatum* by its uniformly brown ascospores and their smaller size. I do not find that characters of hysterothecia or pycnidia are useful in differentiating the two.

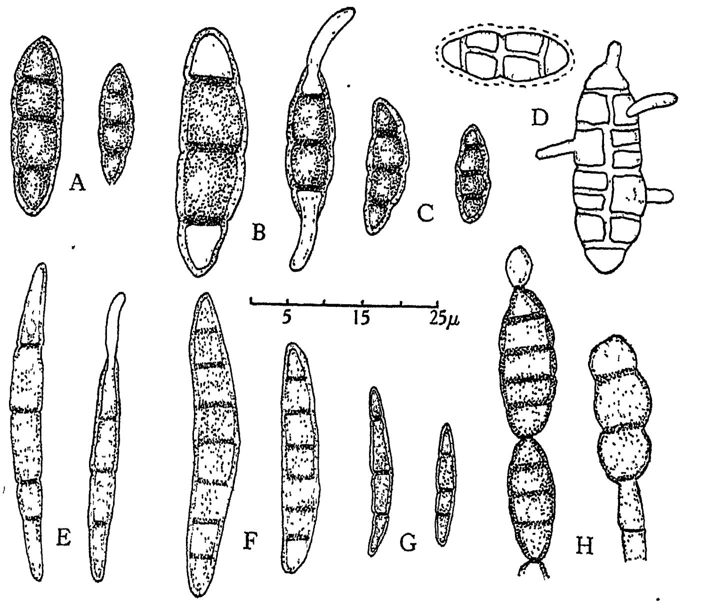

Fig. 1. The approximate range in size of ascospores is given. A, *Hysterium angustatum*. B, *H. pulicare*, one spore germinating; pycnidiospores at left. C, *H. acuminatum*. D, *Gloniopsis levantica* (= *G. curvata*?); the germinating spore has lost its gelatinous outer wall. E, *Mytilidion Karstenii*, one germinating. F, *M. gemmigenum*. G, *M. laeviusculum*. H, *Septonema* spores from culture of *Mytilidion Karstenii*. All × 1000.

(III) *Hysterium acuminatum* Fr. sensu Rehm. *Hysterium acuminatum* Fr. was described on *Fagus* with no mention of spores, and apparently without preserving specimens. Rehm (1887) applied the name to an alpine *Hysterium* on *Pinus* and *Larix*, and described ascospores 12–15 × 5–6 μ. I (1932) measured the spores of Rehm *Ascom.* 125 as 13–16 × 5–6 μ, and Phillips measured them as 14–18 × 5–6 μ (unpublished note in Kew Herbarium).

Hysterium acuminatum has not been recorded for Britain, but there are two specimens in Kew Herbarium, previously un-named, which

I consider to be this species. One is from Cooke's Herbarium, marked "No. 2. Hysterium on Pine Dolgelly June 1876." It was probably sent to Cooke by the Rev. W. A. Leighton. The hysterothecia on thick bark of *Pinus* are nearly superficial, elliptical, 0·4–8 mm. long, about 0·3 mm. wide and the same height, sessile, flat, dull black, groove becoming partially open; asci about $75 \times 10\mu$, 8-spored, 1–2-seriate-overlapping; ascospores $14{\cdot}5$–$18 \times 4{\cdot}5$–$5{\cdot}5\mu$, narrowed and rounded at the ends, 3-septate, uniformly brown, each of the four cells about equal in length.

Another specimen is marked by Berkeley "Hysterium. Norths." It consists of a branch of ? *Larix*, with hysterothecia on the bark similar to those of the Dolgelly specimen but less weathered, and some reach a length of 1·7 mm. The asci and spores are the same in both specimens.

Few or none of the Hysteriales are known to occur on both Gymnosperms and Angiosperms. I consider that these three species of *Hysterium*, all of which have 4-celled ascospores, can be distinguished as follows:

On conifers;	spores 12–18 × 5–6μ, all cells brown...	*H. acuminatum.*
On hardwoods;	,, 15–24 × 5–7μ, ,, ,, ,, ...	*H. angustatum.*
,, ,,	,, 18–35 × 6–10μ, end cells paler	*H. pulicare.*

GLONIOPSIS de Notaris

One of the commonest of the British Hysteriales is a *Gloniopsis* to be found in almost any clump of old *Rubus*, and on branches of various other Dicotyledonous shrubs or trees, or rarely on old herbaceous stems (I have examined specimens on *Rumex* and *Teucrium*). This fungus has the following characters:

Hysterothecia 0·5–3 (5) × 0·3–0·8 mm., 0·3–0·5 mm. high, superficial or erumpent, straight or somewhat curved, parallel or transverse, scattered, gregarious, or crowded; asci 75–120 × 15–20μ, usually 8-spored, irregularly biseriate; ascospores (15) 17–27(32) × 6–10(12)μ, hyaline or pale yellowish, elliptical, usually somewhat constricted at the centre and the upper part of the spore slightly larger, with 3 to 7 cross septa, central cells with 1 or 2 longitudinal septa and often with a cross septum dividing only one of the cells, septa about 1μ wide, outer wall 1–2μ thick, becoming gelatinous and swelling in water until it disappears leaving a very thin inner wall; paraphyses filiform, branched above to form a coloured epithecium beyond the young asci.

I have studied about fifty British collections of *Gloniopsis*. One might base two or three doubtful species on only five well-chosen collections, but the fifty collections seem to represent but one good species. The size and appearance of the hysterothecia depend upon

the host, the weather, etc. I have specimens in which superficial and half-immersed hysterothecia, with exactly similar spores, are adjacent.

The asci show only the variation expected between slight immaturity and the expansion preparatory to discharging spores. The ascospores vary in size and number of cells in different collections, or in the same collection; I have found spores from one fruit-body with a range of 17–31 × 7–11 μ, and only spores which were outside the asci and presumably mature were measured. (This hysterothecium happened to have a number of asci with only two or four spores.)

The variations in measurements of *Gloniopsis* recorded in the literature are due in part to three causes: (1) the spores remain hyaline, and immature spores may be measured in the asci and considered mature; (2) the gelatinous outer wall is sometimes included, sometimes omitted; (3) there is the large "personal factor" of the measurer, including that of knowing what the size is supposed to be.

Cultures from ascospores were made from eleven collections. All cultures were similar, with the expected minor differences in cultural characters. Two cultures from *Rubus* and one each from *Prunus* and *Ligustrum* produced a narrow orange-coloured zone at the margin of the colony on Quaker-oat agar; this zone was not observed in cultures from *Acer*, *Rosa*, *Lonicera*, *Rumex*, *Quercus* or *Salix*; but different lots of agar were used. Pycnidiospores were found in about half the cultures. I found no morphological characters of hysterothecia or spores that I could correlate with these minor differences in culture.

Ascospores discharged upon agar remain hyaline or faintly yellow, swell slightly, the constriction may be obliterated, and germ tubes soon appear from any or all cells.

The colonies grow slowly, are first white then dark with a pale woolly overgrowth. Pycnidia may appear after a month or two. The small pycnidia were so enmeshed in the mat of mycelium that I did not obtain a clear idea of their morphology, but apparently they are similar to those produced by *Hysterium pulicare*. The pycnidiospores (or spermatia?) are 2–4 × 1·5–2 μ, hyaline, borne on slender sporophores 10–15 μ long.

Hilitzer (1929) found pycnidia with similar spores associated with *Gloniopsis biformis* (see below), and named this stage *Hysteropycnis admixta*. Lohman (1933*a*) obtained similar pycnidiospores in cultures of *Gloniopsis Gerardiana* Sacc.

Some analysis is required to ascertain the name for this *Gloniopsis*, now usually called *G. curvata* in Britain.

Fries (1828) cited a Mougeot specimen on *Rosa canina* for *Hysterium elongatum* Wahlenb. ex Fr. var. *curvatum* Fr. Duby (1830) raised the variety to specific rank and cited a Mougeot specimen on *Prunus spinosus*, Vosges. In his Mémoire, Duby (1861) reported that the

spores were hyaline and muriform, mentioned four localities including "Anglia (cl. Bloxam!)", and made *Hysterium naviculare* Wallr. (from Thuringia) a synonym.

Meanwhile Berkeley had recorded *Hysterium curvatum* from Britain in 1851 and 1860 without notes on spores, but a specimen from his Herbarium "May 15, 1841. W. A. L[eighton]" has accurate sketches by Berkeley of three spores, "coat gelatinous", and two asci. A mount shows the spores to be up to 25μ long and typical of our common *Gloniopsis*.

Cooke (*Handbook*, 1871) said the spores of *Hysterium curvatum* were $12\cdot5$–$15 \times 3\cdot5\mu$. This was apparently the first report of measurements of ascospores of *H. curvatum.* Saccardo (*Sylloge*, II, 1883) transferred the species to *Gloniopsis* and gave the spores as "12–$15 \times 3\cdot5\mu$", evidently taken from Cooke. Thus the great weight of the *Sylloge* has supported Cooke's mismeasurements for sixty years. An examination of the specimens in Cooke's herbarium shows that the sizes he gave should be multiplied by about two.

Rehm (1886) renamed Duby's specimens and gave spore-sizes of many of them. *Hysterium naviculare* Wallr. was found to have spores 15–18×6–7μ, hyaline, muriform, with 3–5 cross septa, elliptical, slightly constricted, lower part of the spore somewhat smaller. Bloxam's specimen was described in similar words, and the spores were given as 15–17×6–7μ. Both were considered to be *Gloniopsis curvata*, although neither Duby nor Rehm seem to have examined Mougeot's "type" on *Rosa.*

Rehm found a specimen on *Rubus* in Duby's herbarium from Île du Levant (south coast of France) with spores 21–$24 \times 9\mu$, and named it *Gloniopsis levantica.*

Massee (1895) included *Gloniopsis curvata*, gave the spores as 15–19×6–8μ, published inaccurate figures, and stated "specimen named by Fries examined". (I find no such Friesian specimen in Kew Herbarium.)

Paoli (1905) examined the type specimen of *Gloniopsis curvata* from Fries's Herbarium and reported that the spores were 14–15×6–7μ. Six other specimens studied by Paoli, three from Italy and three from Britain, were found to have spores 18–25×7–9μ, and were referred to *G. levantica* Rehm.

It would appear, therefore, that the name *Gloniopsis curvata* should refer to a small-spored species on the Continent, and that the name *G. levantica* refers to a larger-spored species in the Mediterranean region and in Britain. Material is not available to solve this problem, for Kew Herbarium has no specimen marked *G. levantica*, has about thirty specimens from Britain marked *G. curvata*, but which agree with the description of *G. levantica*, and has no specimen from the Continent marked *G. curvata.*

We must now introduce the name *Gloniopsis biformis*, reported once from Britain for a specimen now apparently lost.

Hysterium biforme Fr. was distributed as *Scler. Suec.* No. 329. It was named "biforme" because some of the hysterothecia are elongate and others short. The specimens of this number at Kew and Paris are *H. angustatum* or *H. pulicare*; Duby found muriform dark spores.

Saccardo found specimens on *Quercus* that were "biforme", assumed that they represented Fries's species, and described them carefully as *Gloniopsis biformis* "(Fr.) Sacc." The following tabulation gives various reports on ascospore characters from Saccardo onward:

	G. biformis			*G. curvata*	
Author	Cross septa	Size μ	Conidia μ	Cross septa	Size μ
Saccardo (1883)	3	14×7–8	4×1	5–7	12–$15 \times 3{\cdot}5$
Saccardo & Roum. (1883)*	3	20–22×8–10	—	—	—
Rehm (1887)	3	15×5–6	—	4–6	15–18×6–7
Schroeter (1893)	4–5	18–24×9–12	—	2–3	15–18×6–7
Paoli (1905)	3	14×7–8	—	4–5	14–15×6–7
Hilitzer (1929)	3–4	15–20×7–8	3–$5 \times 1{\cdot}5$	4–5	16–23×6–9

* Saccardo & Roumeguère at least admitted the possibility that the species might be variable.

Rehm and others have used *Gloniopsis* as a subgenus of *Hysterographium*. Hilitzer, recognizing that the type of *Hysterium biforme* did not belong to the same species as *Gloniopsis biformis* Sacc., renamed the latter *Hysterographium Dubyi* Hilitz.; he also described var. *acuminatum* with ascospores 15–16×6–7μ, and associated pycnidiospores 3–$4 \times 1\mu$.

Part of the specimen which Saccardo described as *Gloniopsis biformis* is at Kew. It has small, mostly immature ascospores 14–16×6–7μ with 3 cross septa, one cell (usually) with a longitudinal septum. I measured the pycnidiospores as 2–$4 \times 1\mu$. There is also a specimen from Wallroth, on *Crataegus*, Thuringia, with spores 13–18×5–6μ, but apparently also immature. The specimen at Kew of Sydow, Mycotheca Marchica 952, marked *Hysterium biforme* Fr., is *Hysterographium elongatum* (Wahlenb. ex Fr.) Corda. There is no other specimen in the *Gloniopsis biformis* folder at Kew.

Thus there are two specimens from the Continent in Kew Herbarium, marked *Gloniopsis biformis*, which may represent the small-spored species that *G. curvata* is supposed to be. Or they may have small spores because they are immature or "off-type". It should be noted that Saccardo's specimen of *G. biformis* has conidia such as one obtains in cultures from the ordinary British *Gloniopsis*. Hilitzer's studies seem to me to indicate that there is one *Gloniopsis* in Czecho-Slovakia resembling the British species, though he referred the specimens to two species and one variety.

There remains the specimen sent to Duby by Bloxam, which Rehm said had spores 15–17 × 6–7 μ. In specimens at Kew from Bloxam and others it is easy to find a hysterothecium with spores of that size, but immature; in British specimens from Bloxam and from others the length of the mature spores reaches 22 or often 25 μ or more. To avoid ambiguity we may designate this common British species *Gloniopsis levantica*.

There are records of four more species of *Gloniopsis* in Britain, each based on a single collection.

1. *Gloniopsis Vaccinii* (Carm. ex Berk.) Boughey in *Trans. Brit. Mycol. Soc.* XXII, 239, 1939. An examination of the type shows that this is *G. levantica*, as Boughey suspected. *G. Vaccinii*, however, does not provide a valid name for the species, because *Hysterium Vaccinii* Carm. ex Berk. is a later homonym of *H. Vaccinii* Schweinitz.

2. *Gloniopsis Muelleri* (Duby) Sacc. was recorded from the Clare Island Survey. Dr Ramsbottom of the Natural History Museum kindly loaned the specimen to me, and I found it to be typical *G. levantica*. A specimen in Kew Herbarium on *Cistus*, Kew, is labelled *G. Muelleri*. It is immature, but probably *G. levantica* also. *Hysterium Muelleri* Duby was described from the Île du Levant (type locality of *Gloniopsis levantica*). Part of the type specimen is at Kew. I have examined it and consider that it may be the same as *G. levantica*. Rehm (1886, 148) gives a description which suggests *G. levantica*. However, *G. Muelleri* is a more or less forgotten name which, in my opinion, might better remain forgotten.

3. *Gloniopsis decipiens* de Not. was recorded (*Trans. Brit. Myc. Soc.* III, 282) from Wales on palings, probably of *Quercus*. This specimen is not available at the moment and Miss Smith's description was apparently taken from Rehm.

The genus *Gloniopsis* was based on *G. decipiens*. Rehm (1887) records only the type and a collection on *Quercus* "in Franken". It was thought to differ from *G. levantica* in having rather larger spores (21–30 × 9–12 μ) without constriction.

I have seen two or three British collections which might be referred to *Gloniopsis decipiens*; one "on a gate", coll. Dr Watson, comm. F. Rilstone, has spores up to 32 μ long, many-celled, with little or no constriction. I consider it better, however, to consider that *G. decipiens* represents *G. levantica* with well-developed spores, while Saccardo's *G. biformis* may be *G. levantica* with poorly developed spores. Certainly the *Gloniopsis* one usually collects on *Quercus* has the intermediate spores of *G. levantica*.

Kew Herbarium has no authentic material of *Gloniopsis decipiens*; *Rabenhorst Herb. Mycol.* Ed. II, No. 573 so labelled is a *Hysterographium*, and *Roum. Fungi Sel. Exs.* No. 5451 "f. *Pini*" on *Pinus* is apparently without hysterothecia. I found only the same two Exsiccati at the Bot. Mus., Berlin, and I did not find a good specimen at Paris.

4. *Gloniopsis Watsonii* Rilstone in *J. Bot.* 1940, p. 192 is described with spores up to $51 \times 21\mu$. I have not studied it, but it is certainly different from all other British collections of *Gloniopsis*.

DICHAENA Fr.

Dichaena faginea (Fr.) Fr. and *D. quercina* (Fr.) Fr. are amongst the most common and uninteresting fungi in Britain. I have looked at many specimens but have never found an ascus.

Dichaena was first considered a Lichen. Roper (1874) (taken from *Monthly Microscopical Journal* which I have not seen) reported asci with spores "oval, the largest about 0·001 inch in length; they are filled with granular matter, of a pale brownish tinge variegated by a mixture of bluish-green". Roper also reported algal cells associated, but Cooke added a note saying he was changing his mind (he had previously thought *Dichaena* a Lichen) and suggested that the algal cells were accidentally present.

About 1876 Cooke issued *Fungi Brit. Exs.*, Ed. II, No. 464 with a printed sketch of a clavate ascus with eight spores, a paraphysis, and a one-celled spore with "granules". This is the earliest figure of ascospores I have found; and I suggest that neither Roper nor Cooke ever saw an ascus or ascospore of *Dichaena*.

In 1881, Saccardo thought he saw diffluent asci with four-celled ascospores in *Dichaena quercina*, and in 1883 he figured an ascus and spores. The size of the ascus was not given, but the figure shows an ascus nearly cylindrical. In 1887 Rehm reported that he had seen pyriform asci, $45–50 \times 25–27\mu$, in one of his specimens, but since he found no developed ascospores he quoted Saccardo's description of spores. Rehm's figures of ascospores do not agree with the description, but resemble Cooke's hypothetical ascospores.

Massee (1895) then redrew Rehm's figures, but carefully placed three septa in the ascospores, except those in the ascus which he accidentally drew as muriform. Meanwhile Ellis and Everhart (1892) thought they found clavate asci $80–90 \times 20\mu$ with septate ascospores $20–24 \times 7–8\mu$.

Paoli (1905) decided that Saccardo's supposed ascospores were pycnidiospores, for which he proposed the new genus *Dichaenopsis*; he found *Melogramma* on Ellis and Everhart's specimen; he found an Italian specimen of *Dichaena quercina* with compressed asci $80 \times 26 \times 15\mu$ and ascospores $18–20 \times 13\mu$, one-celled, hyaline then brown. He also figured and described *Psilospora Quercus* with hyaline one-celled pycnidiospores (similar to those of *P. faginea*) but other workers consider that *P. Quercus*, the supposed pycnidial state of *Dichaena quercina*, has pycnidiospores becoming septate. Diedecke proposed the genus *Psilosporina*, which is presumably a synonym of *Dichaenopsis*.

Thus it must be concluded that the pycnidial state of *Dichaena quercina* is nearly as uncertain as the ascigerous. I can add no information, for my experience is the same as Grove's (1937): "common... but always barren".

In 1914 Arnaud figured *Dichaena quercina*, without discussion. His illustration of a section of a fruit-body shows structures that look like asci, but no spores are shown within. Arnaud figures "ascospores" which look like pycnidiospores of *Psilospora Quercus* sensu Paoli.

In 1918 von Höhnel reported that he did not find ascospores, but he accepted Paoli's description of them.

Apparently no one has yet thought he had seen an ascus in *Dichaena faginea*, though they are reported for its var. *Capreae* Rehm. The third species of *Dichaena* recorded in Britain, *D. strobilina* (Fr.) Fr., is especially doubtful, though Cooke reported ascospores in 1871.

The so-called pycnidial state of *Dichaena faginea*, *Psilospora faginea* Rabenh., is sometimes found. E. W. Mason collected good specimens on an exposed root of *Fagus*, at Ranmore Common, Surrey, 12 Feb. 1939. The pycnidiospores were $12\text{–}28 \times 8\text{–}15\mu$, hyaline to pale yellow, granular, borne on slender sporophores. I made several cultures, then placed the *Psilospora* in a damp chamber, but no asci developed. I watched the cultures for several months, but found only brownish mycelium and minute microconidia or spermatia.

Dichaena should be removed from the Ascomycetes until someone is sure he has seen an ascus and ascospores. This genus, though very common in Europe and North America, has been reported to have ascospores that belong to Hyalosporae, Phaeosporae, Hyalophragmiae, and possibly to Phaeophragmiae; but most mycologists have never been able to find its ascospores at all. I would place *Dichaena* in the Sphaeropsidales, with *Psilospora* as a synonym, although there is doubt even as to its place in the Fungi Imperfecti. I hope someone with more patience may ascertain the facts about *Dichaena*, *Psilospora*, and *Dichaenopsis*.

MYTILIDION Duby

Mytilidion and *Lophium* differ from other lignicolous and corticolous Hysteriales in Britain in their erect, conchiform or mussel-shaped, thinner-walled hysterothecia. Three species of *Mytilidion* have been recorded for Britain, two of them apparently based on one collection.

Mytilidion decipiens (Karst.) Sacc. was reported by Bucknall (as *Lophium*) on pine wood near Bristol, coll. Mar. 1885. Bucknall's herbarium was not saved, but part of this collection was sent to Cooke and is now in Kew Herbarium. It is not *M. decipiens* but *M. laeviusculum*.

Mytilidion laeviusculum (Karst.) Sacc. is recorded by Massee (1895) "on worked pinewood". No British specimen is in the *M. laeviusculum* folder at Kew, so I presume Massee may have examined Bucknall's

specimen, although he did not mark it or remove it from the *M. decipiens* folder.

This specimen bears a few small, erect hysterothecia with asci about $80-90 \times 6\mu$, ascospores $16-22 \times 2{\cdot}5-3\mu$, 1–3-septate, brown.

No imperfect stage is known for *M. laeviusculum*, and Lohman (1933 *b*) obtained none in cultures from the only recorded American collection. Lohman (1939) restudied Karsten's type specimen. Part of the same collection was distributed as *Fungi Fenn.* No. 771. I found that this number at Berlin had ascospores, but not its counterpart at Kew. *M. laeviusculum* seems to be a rare species in Europe; Kew has only the Finnish specimen and Bucknall's, and Berlin only a couple of collections from Karsten.

Mytilidion gemmigenum Fuckel is represented at Kew by several specimens, including the following from Britain: (1) one or two collections from Bloxam on "Scotch fir", in which I found no ascospore, but the erect hysterothecia and a sketch of spores beside one specimen indicate that it is *M. gemmigenum*; (2) a collection on bark of *Larix*, Worcs., ex Herb. J. W. Ellis, in which the asci are immature; (3) several parts of one or two collections by Plowright, King's Lynn, apparently on *Larix*. These were distributed by Cooke as *Fungi Brit. Exs.* No. 580 and ibid. Edit. 2, No. 200, both under the name *Lophium mytilinum*. In 1876, Cooke decided to name No. 200 *L. fusisporum* Cooke, which Saccardo transferred to *Mytilidion*. Massee (1895) made *M. fusisporum* a synonym of *M. gemmigenum*.

These Plowright specimens—the only British collections I have seen with asci and spores—do not provide many data, but I found the asci to be about $100 \times 10\mu$, with 8 or sometimes fewer spores; ascospores $30-40 \times 5-6\mu$, usually 7-septate. *Mytilidion gemmigenum* seems to be the correct name, but I have been unable to study an authentic specimen, since I found no hysterothecium on Fuckel's *Fungi Rhenani*, No. 2433 at Kew. Rehm's *Ascomyceten*, No. 129 on *Pinus* has spores similar to those mentioned above, but up to 8μ wide and to 9-septate.

A third species of *Mytilidion* was collected by Mrs Una C. Mason near Ludlow on a fallen branch of *Pinus*, 25 Sept. 1937. The hysterothecia are on bare wood, erect, 0·04–0·08 mm. long; asci $125-150 \times 8\mu$, 8-spored; ascospores $28-42 \times 3{\cdot}5-4\mu$, brown, 3–4(5)-septate, slightly or not constricted at the septa.

This is evidently *Mytilidion Karstenii* Sacc., as redescribed by Lohman (1939) from the specimen he considered the type; it is a new record for Britain. The only European specimen marked *M. Karstenii* in Kew Herbarium is one correctly determined by Massee, with ascospores $30-40 \times 3{\cdot}5-5\mu$, 3–4-septate. No locality is given, but it may have been a British collection.

Ascospores from the Ludlow specimen germinated always from one

and sometimes from both of the terminal cells, and produced a woolly blackish mycelium and the abundant conidia of a *Septonema*. Lohman observed the same *Septonema* associated with the type specimen. No specific name has been found for this stage. Lohman (1933*b*) obtained *S. toruloideum* Cooke & Ellis from ascospores of *Mytilidion scolecosporum* Lohman.

A word must be said about *Mytilidion aggregatum* (DC. ex Fr.) Duby, the type species of the genus, and *M. rhenanum* Fuckel. Duby (1861) described and figured the genus with ascospores first simple, hyaline, elliptic, then with three cross-septa, the two middle cells pale brown. He cited for *M. aggregatum* a Chaillet specimen, Fries's Scler. Suec. 351 issued as *Lophium aggregatum* (DC.) Fr., *Hysterium aggregatum* DC., and a Lamy specimen from which he apparently drew his figures. Kew has part of the Chaillet specimen, collected 1816, but I found no spore; it has also three parts of Scler. Suec. 351, but I found no spores on those either. As Kew has no other specimen of *Mytilidion aggregatum*, I can give no new information about the species.

Fuckel issued *Fungi Rhenani*, No. 761 as *Mytilidion aggregatum*, and gave (*Symb. Myc.* p. 93, 1869) the spores as 38×3–6μ, 3–5-septate, yellow when mature. In Nachtrag 1, 1871, he decided that his No. 761 did not agree with Duby's figures, so he described it as *M. rhenanum* Fuckel; and now said the spores were 36–38×4–6μ, 3-septate, brown.

The Kew specimen of Fuckel No. 761 has ascospores 32–$44 \times 3{\cdot}5$–$4{\cdot}5\mu$, brown, 3–5-septate, and is the same as *Mytilidion Karstenii*. Rehm (1887) and others give the spores of *M. rhenanum* as 24–27×5–6μ. Hilitzer (1929) makes *M. rhenanum* a synonym of *M. aggregatum*, and gives the ascospores as 20–$27 \times 7\mu$. Possibly Fuckel distributed two species in his 761. In view of this uncertainty, I use the name *M. Karstenii* for the British specimen.

FARLOWIELLA Sacc.

E. W. Mason (1941) has just reported on this genus and its one species, with the conidial stage *Monotospora megalospora* Berk. & Br.

Discussion and Summary

With *Dichaena* excluded, the lignicolous and corticolous Hysteriales constitute a fairly homogeneous group easily recognized by the elongate fruit bodies, or hysterothecia. But the numerous cultures reported by Lohman (1933 and subsequently), and the few reported here, show that there is no corresponding similarity in their conidial stages, which are sometimes pycnidial, sometimes Hyphomycetous. Nor do genera with erect hysterothecia, such as *Mytilidion*, have conidial stages distinct from those of genera with non-erect hystero-

thecia; a *Septonema* stage was found by Lohman for *Hysterium insidens* as well as for certain species of *Mytilidion*; other species of *Mytilidion* and *Hysterium* have pycnidial stages.

Three species of *Hysterium* are known in Britain. *H. angustatum* is fairly common, *H. pulicare* rather less common, and *H. acuminatum* apparently rare. These three species are somewhat similar in morphology, but are almost always easily distinguishable.

Gloniopsis Watsonii is known only from the type collection, and I am uncertain about it. The common British *Gloniopsis* on various woody Dicotyledonous branches and stems seems to me to constitute one species, as neither morphological nor cultural characters have provided criteria for distinguishing two or more species. I have accepted for this the name *G. levantica.* It is possible that the name *G. curvata* refers to a smaller-spored species on the Continent, and even in Britain also; until that is demonstrated more clearly, some may prefer to follow tradition and call the British species *G. curvata.* The pycnidial stage appears to be a *Hysteropycnis.*

Mytilidion and *Farlowiella* have rarely been collected in Britain. *Mytilidion Karstenii* produces a *Septonema* stage. *Mytilidion laeviusculum* and *M. gemmigenum* have been reported previously from Britain.

Dichaena has long been classified as an Ascomycete, but should be placed in the Fungi Imperfecti until ascospores are really known.

Precise formal descriptions of species of Hysteriales in Britain, and full synonymy, can scarcely be given until other European specimens are studied more carefully.

Acknowledgements. About twenty years ago Sir Edwin Butler and E. W. Mason suggested (rightly) that the Hysteriales needed some study. The authorities of the Royal Botanic Gardens, Kew, have always allowed me to feel at home in the Herbarium, and Miss Wakefield has helped me in various ways. Dr C. G. C. Chesters and Mr F. Rilstone have kindly placed numerous specimens at my disposal.

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EXPLANATION OF PLATE V

Fig. 1. *Gloniopsis levantica* (=*G. curvata* of British mycologists) on cortex of *Rosa*. × 25.
Fig. 2. *Hysterium angustatum* on wood of *Fraxinus*, × 25. The genus cannot be determined by appearance of hysterothecia.
Fig. 3. *Mytilidion Karstenii* on wood of *Pinus*, × 25. The hysterothecia are erect, and narrowed below.
Cultures were made from the three collections photographed.

(*Accepted for publication 20 February 1941*)

Fig. 1

Fig. 2

A METHOD FOR CHARACTERIZING SMUT FUNGI EXEMPLIFIED BY SOME BRITISH SPECIES

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In the course of studies on the Ustilaginales the need was felt for a shorthand method of recording the principal characters of each species examined. Suggested by the numerical formulae used for bacteria and the formulae proposed by Beeli (1920) and by Stevens (1927–8), for species of *Meliola*, the method developed consists in assigning to each species a formula of twelve numerals. The first four numerals (A) represent macroscopic characters (or characters which require only supplementary microscopic examination), the second four (B) microscopic characters, and the third four (C) measurements; the numeral for each character being selected by reference to the following table:

A. Macroscopic characters

1st numeral: *The position of the sorus*

Sori:

A, in the ovaries (or replacing the flower parts within the perianth)	1
B, in the seeds of fruits (1)*	2
C, in the anthers	3
D, in the inflorescence (including peduncle and pedicel) ...	4
E, transforming the floral axis into a long curved leafless structure (2)	5
F, in the leaves and/or stems	6
G, in the flowers (or inflorescence), leaves, and stems ...	7
H, in roots, tubers, or other underground parts	8

2nd numeral: *The covering of the sorus*

Sorus:

A, not delimited by an evident false membrane of fungal tissue (protective covering, when present, of host tissue)	0
B, delimited by an evident false membrane of fungal tissue	1

* See notes at the end of this table.

3rd numeral: The internal structure of the sorus

Sorus:

A, not traversed by a columella or by threads of host tissue ... 0

B, traversed by:

(A) a central columella [3] that is

a, simple 1

b, forked or branched 2

(B) several to numerous strands of host tissue arising from the base of the sorus [4] 3

(C) very numerous fine elater-like threads of host tissue [5] 4

4th numeral: The macroscopic appearance of the spore mass

Sorus:

A, opening on the host to expose:

(A) a dusty spore mass that is:

a, black (olivaceous black, or purplish black) ... 1

b, brown (olivaceous brown, or reddish brown) ... 2

c, purple (pinkish, or reddish purple) 3

d, pale (light brown, fawn, or yellow) 4

(B) an agglutinated spore mass 5

B, not opening on the host, permanently embedded in the host tissue or enclosed in a seed or fruit; the spore mass being:

(A) coalescent or agglutinated 6

(B) not coalescent or agglutinated; dusty 7

B. Microscopic characters

5th numeral: The microscopic appearance of the spore mass

In mature sori, the spore mass:

A, homogeneous, consisting of mature spores or mature spore-balls only 1

B, heterogeneous, consisting of mature spores or mature spore-balls intermixed with:

(A) sterile cells which are not an integral part of a spore-ball (frequently derived from the false membrane), or sterile or permanently immature spores [6] ... 2

(B) sterile mycelial threads [7] 3

6th numeral: Spores single, in pairs, or in balls

Spores:

A, not in balls:

(A) single 1

(B) in pairs [8] 2

B, united into balls composed of:

(A) fertile spores only, the spores:

a, not bound together by thickenings or ridges of outer wall [9] 3

b, bound together by thickenings or ridges of outer wall [10] 4

(B) fertile spores and sterile cells, each ball having:

a, a sterile cortex enclosing:

(*a*) one or more fertile spores only [11] 5

(*b*) fertile spores and sterile cells or hyphae [12] ... 6

b, a fertile surface composed of:

(*a*) one to several layers of spores [13] enclosing sterile cells or tissue 7

(*b*) a single layer of spores enclosing a network of septate filaments [14] 8

c, the spores and sterile cells intermixed [15] 9

7th numeral: Spore ornamentation [16]

Each spore:

A, without an elongate hyaline appendage: its exospore:

(A) smooth 0

(B) apparently smooth but obscurely ornamented when highly magnified, or granular 1

(C) punctate 2

(D) verruculose to verrucose; [17] tuberculate 3

(E) echinulate to spiny [18] 4

(F) papillate 5

(G) scaly 6

(H) striate 7

(I) reticulate 8

B, with an elongate hyaline appendage [19] 9

8th numeral: Spore coloration

Mature spores:

A, homogeneous, i.e. all the spores similar; individual spores:

(A) evenly coloured:

a, hyaline to tinted 1

b, pigmented 2

c, densely pigmented to opaque 3

(B) more strongly pigmented on one side than the other [20] 4

B, heterogeneous: outer spores of a spore-ball more strongly pigmented than the inner spores 5

C. Measurements [21]

	9th numeral	*10th numeral*	*11th numeral*	*12th numeral*	
	Mean max. spore diam. in μ	Mean max. spore-ball diam. in μ	Mean sorus length in cm.	Mean max. diam. of sterile cells, sterile spores, cells of false membrane, sterile cortical cells of spore ball, or conidia of an *Entyloma* in μ	
1	5 or less	20 or less	0·5 or less	5 or less	1
2	7·5	30	1·5	7·5	2
3	10	40	2·0	10	3
4	12·5	60	3·0	12·5	4
5	15	80	4·0	15	5
6	17·5	100	6·0	17·5	6
7	20	125	8·0	20	7
8	25	150	10·0 or more	25	8
9	30 or more	200 or more	indefinite [22]	30 or more	9

Notes

(1) As when the spores remain enclosed within the fruit or seed after detachment from the plant, e.g. *Tilletia Caries* on wheat and *Ustilago seminis-convolvuli* on *Convolvulus*.

(2) As in *Ustilago scitaminea* on sugar-cane.

(3) 'Columella' is interpreted broadly. Besides the typical columella found in species of *Sphacelotheca*, a culm completely surrounded by a sorus as that of *Ustilago hypodytes* is considered to be a columella.

(4) As in some tropical species of *Sorosporium*, e.g. *S. Tembuti.*

(5) As in *Farysia.*

(6) Sterile cells derived from the false membrane are often exhibited by *Sphacelotheca* and *Sorosporium*; sterile or immature spores by *Tilletia.*

(7) As in *Farysia.*

(8) As in *Schizonella*, *Schroeteria*, and *Mycosyrinx.*

(9) As in *Sorosporium.*

(10) As in *Tolyposporium.*

(11) As in *Urocystis.*

(12) As in *Testicularia.*
(13) As in *Doassansiopsis.*
(14) As in *Tracya.*
(15) As in some species of *Burrillia.*
(16) An asterisk is used to denote ornamentation confined to one side of a spore. Thus when a spore from a spore ball is echinulate only on its free surface it is recorded as 4*.
(17) Verrucose, warty; verruculose, minutely warty.
(18) Echinulate, minutely spiny; spiny, strongly echinulate.
(19) As in *Neovossia.*
(20) As in *Ustilago Tritici* and *U. Avenae.*
(21) At first the maximum length was recorded but the mean was found to give slightly less variable results. The mean is that of ten measurements, taken at random but with the proviso that the largest and smallest individuals observed are measured. The calculated mean is referred to the nearest class in the table.
(22) 'Indefinite' includes irregular sori on leaves and stems.

EXAMPLES

The use of the method may be exemplified by the formulae for the Loose and Covered Smuts of Sorghum. The first, *Sphacelotheca cruenta* (Kühn) Potter is represented by:

1112.2102.2014,

which may be expanded as follows:

Sori in the ovaries, [conspicuous], average length 0·5 cm. or less [but occasionally larger], limited by an evident [somewhat evanescent, cream-coloured] false membrane [which disintegrates at maturity to expose] a [dark] brown, dusty spore mass surrounding a [long, curved, well-developed] simple columella [of host tissue]; spores intermixed with [groups of globose to subglobose, hyaline] sterile cells, [9–16] (av. 12·5) μ in length; spores single, [globose to subglobose], smooth, evenly pigmented [light reddish brown, 6–10] (av. 7·5) μ in length.

(The square bracket insertions give supplementary information not indicated by the formula.)

The formula for the second, *Sphacelotheca Sorghi* (Link) Clint. is:

1112.$\frac{1}{2}$102.1012,

and can be expanded on similar lines. The fifth term indicates that the character in question is usually 1 but sometimes 2, i.e. 'spores not usually but sometimes intermixed with [chains of subglobose, hyaline] sterile cells [derived from the false membrane, 4–8] (av. 7·5) μ in length'.

Further examples are given in the Appendix where the formulae for 45 British smuts, based on an examination of specimens, are set out.

Applications

No claim is made that a species can be completely described by a formula. It is only claimed that the construction of a formula assists the adequate description of any species. Although the characters set out in the above table vary in importance for generic or specific characterization each merits consideration for specific descriptions; and the mere making of the observations necessary to prepare a formula ensures a systematic examination of the specimens. Only too frequently is it impossible to complete the first two sections of the formula from the published description of a smut.

There has been a greater tendency to raise physiologic races to specific rank in the Ustilaginales than in most other groups of fungi and formulae help to emphasize morphologically similar types that occur on different host plants.

Collections of formulae may be arranged in various ways as identification keys. They may be arranged in order (as in the Appendix) when to name a specimen its formula is determined and then matched with the list. By this method use of the host plant is sometimes necessary (particularly in the genus *Entyloma*) to separate species with identical formulae. Recourse to the host plant compares favourably with their use for the final separation of species in the usual type of dichotomous key. A second method is to group the formulae under the host genera which is in some ways more useful than the first for the name of the host plant is usually known. Duplication, however, results when one species has to be entered under several genera and the key breaks down whenever an already described smut is first recorded on a new host genus. A third alternative is to transfer the formulae to perforated cards of the type used by Clarke (1938) when the multiple-entry keys so obtained can be approached via any character. A 5 × 8 Paramount Sorting Card allows geographical distribution or other information to be recorded as well as the 85 entries in the table and the cards can be quickly sorted for any desired set of characters.

Summary

A method is described by which the principal characters of a smut fungus can be summarized by a formula comprised of twelve numerals. The method is illustrated by formulae for the commoner British smuts.

I am indebted to Miss K. Sampson for supplying material and to those in charge of the Herbarium of the Royal Botanic Gardens, Kew, and the Herbarium of the Ministry of Agriculture's Plant Pathological Laboratory for allowing me access to specimens.

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APPENDIX

The formulae of some British smuts

Formula	Host	Smut
1001.2182.9015	*Agrostis*	*Tilletia decipiens* (Pers.) Körn.
1001.2182.9017	*Holcus*	*Tilletia Holci* (West.) Schroet.
1002.2182.7015	*Lolium*	*Tilletia Lolii* Auers.
1002.2182.8015	*Phalaris*	*Tilletia Menieri* Har. & Pat.
1003.1181.2010	*Oxyria*	*Ustilago vinosa* (Berk.) Tul.
1003.1182.5010	*Polygonum*	*Ustilago utriculosa* (Nees) Tul.
1015.1101.7010	*Carex*	*Cintractia Caricis* (Pers.) Magn.
1042.3132.2010	*Carex*	*Farysia olivacea* (DC.) Syd.
1111.1131.5015	*Polygonum*	*Sphacelotheca Hydropiperis* (Schum.) de Bary
2007.133*2.5210	*Convolvulus*	*Thecaphora seminis-convolvuli* (Desm.) Liro
2007.2182.6014	*Triticum*	*Tilletia Caries* (DC.) Tul.
3002.1112.3010	*Scilla*	*Ustilago Vaillantii* Tul.
3003.1181.2010	*Dianthus*	*Ustilago violacea* (Pers.) Rous.
3003.1181.3010	*Silene*	*Ustilago major* Schroet.
3004.1181.3010	*Scabiosa*	*Ustilago Scabiosae* (Sow.) Wint.
4001.1132.3010	*Bromus*	*Ustilago bromivora* (Tul.) Fisch. v. Wald.
4001.1182.4090	*Tragopogon*	*Ustilago Tragopogi-pratensis* (Pers.) Rous.
4002.1104.3010	*Avena*	*Ustilago Kolleri* Wille.
4002.1144.2010	*Arrhenatherum*	*Ustilago perennans* Rostr.
	Avena	*Ustilago Avenae* (Pers.) Jens.
	Hordeum	*Ustilago nuda* (Jens.) Rostr.
	Triticum	*Ustilago Tritici* (Pers.) Rostr.
4003.133*2.5190	*Carduus*	*Thecaphora Trailii* Cooke
4005.1104.3010	*Hordeum*	*Ustilago Hordei* (Pers.) Lagerh.
6001.1502.4192	*Allium*	*Urocystis Cepulae* Frost
6001.1502.5192	*Secale*	*Urocystis occulta* (Wallr.) Rabenh.
6001.1502.5292	*Agropyron*	*Urocystis Agropyri* (Preuss) Schroet.
	Colchicum	*Urocystis Colchici* (Schlect.) Rabenh.
6001.1502.5293	*Anemone*	*Urocystis Anemones* (Pers.) Wint.
6001.1502.5392	*Viola*	*Urocystis Violae* Fisch. v. Waldh.
6001.1502.6293	*Carex*	*Urocystis Fischeri* Körn.
6001.1503.5393	*Thalictrum*	*Urocystis sorosporioides* Körn.
6002.1101.1090	*Glyceria*	*Ustilago longissima* (Sow. ex Schlect.) Meyen
6002.1102.5090	*Gagea*	*Ustilago Ornithogali* (Schum. & Kunze) Magn.
6002.1132.3090	*Holcus*	*Ustilago striaeformis* (West.) Niessl
6005.1103.5090	*Linaria*	*Melanotaenium cingens* (Berk.) Magn.
6005.1103.6090	*Galium*	*Melanotaenium endogenum* (Ung.) de Bary
6007.1101.3010	*Ranunculus*	*Entyloma microsporum* (Ung.) Schroet.
6007.1101.40$^{8}_{9}$0	*Dahlia*	*Entyloma Dahliae* Syd.
6007.1302.4590	*Trientalis*	*Tuburcinia Trientalis* B. & Br.
6007.1501.3696	*Sagittaria*	*Doassansia Sagittariae* (West.) Fisch.
6012.1102.1090	*Agropyron*	*Ustilago hypodytes* (Schlect.) Fr.
7002.1142.3090	*Zea*	*Ustilago Zeae* (Beck.) Ung.
7003.2182.6017	*Rumex*	*Ustilago Kühneana* Wolff
8002.1102.4010	*Scirpus*	*Ustilago marina* Durier.

(*Accepted for publication* 20 *February* 1941)

THE INVALIDITY OF THE GENUS *PYTHIOMORPHA*

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(With 2 Text-figures)

Introduction

In 1937 Dr M. P. Hall kindly presented to this laboratory a water-mould which she had collected on an apple dropped into a pond near Manchester and had later isolated and grown in pure culture. She had identified it as *Pythiomorpha gonapodyides* and we accepted it as such, since it showed the characteristic undulating hyphae and proliferating sporangia. The habitat was a likely one for *Pythiomorpha*. During the months of January to May in the two years when Dr Hall was collecting, the hydrogen ion concentration ranged from 6·0 to 8·0. This corresponded to the 'neutrally alkaline' and 'constantly alkaline' waters of Lund (1934), who found five species of *Pythiomorpha* in Denmark. It is true that this strain bore oogonia and antheridia in abundance, an unusual feature in *Pythiomorpha*; but Forbes (1935) had reported abundant sex organs on the material collected by her in Bristol and it was assumed that this was a similar strain.

It appeared to be favourable material for a full study of this little known genus, which was therefore undertaken by one and later by another of us. But as the investigation proceeded it became evident that there was not a generic difference between this isolate and the strain of *Phytophthora Cactorum* which had been under observation in this laboratory for many years and of which a detailed description was available. On the other hand there was no species of *Phytophthora* on record that occurred as a water-mould. It is true, there is the notice by Bewley and Buddin (1921) that the disease-causing organisms *Phytophthora cryptogea* and *Phytophthora parasitica* are transported in glasshouse water; and there is the description by Shanor (1938) of a new species of *Phytophthora* with proliferating sporangia viz. *Phytophthora stellata* Shanor, found on petals of *Rhododendron maximum* fallen into water at a high altitude in North Carolina. But concerning this last species Mr S. F. Ashby, who grew it and observed its spore formation, has suggested that it is a species of *Pythium*.

Mr Ashby at the Imperial Mycological Institute diagnosed Dr Hall's isolate as *Phytophthora megasperma*. This was confirmed by Dr Tucker. This then is the second record of a species of *Phytophthora* found growing as a saprophytic water-mould. The first tentative record is of *Phytophthora cryptogea* isolated by one of us from the water of the Hogsmill River and assumed at first to be *Pythiomorpha gonapodyides* (Waterhouse, 1940). In view of the widespread occurrence of the species of *Phytophthora* and their partiality for and dependence on water it seems surprising that no earlier records have been made.

Two questions naturally arose. Have species of *Phytophthora* been mistaken for *Pythiomorpha gonapodyides* on other occasions? Are the records of *Pythiomorpha gonapodyides* all of the same fungus? An attempt was made to procure a culture of *Pythiomorpha gonapodyides* for comparison. Petersen's and von Minden's strains were no longer in culture. Kanouse, we found on enquiry, had given up re-culturing her isolate but had sent a culture to the Centraalbureau of Schimmelcultures at Baarn. We obtained a subculture of this from Baarn in the summer of 1939; also an isolate of their own, identified as *Pythiomorpha gonapodyides*. The latter turned out to be a species of *Phytophthora*, the former to be a species of *Pythium*. This strain had the habit of a *Pythium*. It bore no sex organs, no sporangia but abundant chlamydospores. Sporangia were encouraged to form by culturing on prune in water according to the method given by Kanouse. First prosporangia formed and then secondary sporangia in which the zoospores matured. It was without doubt a species of *Pythium*. It was later discovered that Tucker (1931) had sent to Baarn for a culture. He wrote (p. 141): 'A culture of this fungus received from Baarn failed to produce either sporangia or oöspores and soon died. The mycelial development was more like *Pythium* than *Phytophthora*, but insufficient data were obtained to determine its relationships.' Drechsler (1930) too, wrote of Kanouse's strain. 'In the hands of the present writer the presumably identical organism never produced zoospores within the sporangium to discharge them full fledged through an orifice provided by a uniformly sessile papilla. On the contrary, development took place as in typical representatives of *Pythium*.' We reported our observation to Miss Kanouse, who in a letter dated 25 January 1941 agreed that some contamination had crept in and that what we had received from Baarn was a species of *Pythium*. So Kanouse's strain is lost too.

An enquiry into the literature revealed the very slender grounds on which the genus *Pythiomorpha* is separated from *Phytophthora*. The proliferating nature of the sporangia which was the outstanding characteristic of the new genus has since been shown to be a familiar feature of several species of *Phytophthora*. Other characters such as the undulating hyphae, the repetitional development of the zoospores,

the variable presence of a vesicle are all to be found within the genus *Phytophthora*.

This enquiry showed too that the validity of the new genus had been questioned on more than one occasion: Buismann (1927), Fitzpatrick (1930), Drechsler (1930 and 1931), Sparrow (1935). Meanwhile new species have been erected which has only added to the confusion. The matter seemed worth investigation.

The genera concerned

There are only two genera with which *Pythiomorpha* could be confused, viz. *Pythium* and *Phytophthora*, and these are undoubtedly closely allied to one another.

Pythium is marked out by the development of a prosporangium in which the protoplasm prepares for the formation of spores. At a certain stage this protoplasm is passed through a discharge tube into a secondary sporangium in which the zoospores mature. This secondary sporangium is sometimes called a vesicle.

Phytophthora differs from *Pythium* in one respect only, that the zoospores are matured within a sporangium which forms directly from a slender hypha. The sporangium may or may not produce an evanescent vesicle when the ripe zoospores escape.

Historical survey

Pythiomorpha gonapodyides was described by Petersen (1909, 1910) as a new genus and a new species and put into a new family Pythiomorphaceae in the Saprolegniineae together with Leptomitaceae and Saprolegniaceae.

The reason for the creation of *a new family* appears to have been negative. The presence of cellulose in the hyphal membrane, and of the refractive granules 'believed to be cellulin' in the protoplasm of the new species, presumably determined its inclusion in the Saprolegniineae although not in either of the two families which made up that cohort.

The genus was founded on the absence of a vesicle on emission of zoospores from the sporangium, and on the colour reaction of the hyphae with chlor-zinc iodine. 'Mycelium ramosum, membrana chlor. zinc. jodato rubro-violaceo colorata. Propagatio adhuc cognita zoosporis duobus ciliis lateralibus munitis, vesica non cinctis exeuntibus efficitur.' Petersen says elsewhere that with chloroiodide of zinc the membranes of the hyphae adopt exactly the same colour as hygroscopic cotton and the refractive granules are coloured yellow and finally dissolved.

The new species was founded on the 'intramatrical irregular, branched mycelium with irregular thickenings of the membrane',

and the proliferating sporangia. 'Mycelium intramatricale ramosum irregulariter tumoribus et parietibus undulatis instructum. Mycelium extramatricale hyphis erectis non ramosis diam. 4–5μ constat. Zoosporangia terminalia ovalia diam. *c.* $44\mu \times 22\mu$. Zoosporae ut *Saprolegnia* non vesica cinctae, ellipsoidae, duobus ciliis lateralibus munitae, diam. 10μ, exeunt. Hyphae in et per zoosporangia evacuata penetrant et nova sporangia repetite formant.' He did not observe oogonia and antheridia.

Petersen collected his new species from 'old apples in a pond in a garden in the neighbourhood of Glostrup in August 1902 and May 1903, and in the channel near Friederiksdal, and on alder in a pond of alders in the wood of Ruder Hegn, October 10, 1902'. He published drawings of the form of the mycelium but did not illustrate undulating hyphae. He gave one measurement of sporangia, viz. $22 \times 44\mu$. In the same account of Danish Freshwater Phycomycetes Petersen listed under Pythiaceae in the Peronosporineae two species of *Pythium*, viz. *Pythium proliferum* de Bary 'on leaves and stems of old *Nymphaea* and on the decayed flower of a *Nuphar*', and *Pythium undulatum* sp.nov. on the same substratum. He stated that the new species of *Pythiomorpha gonapodyides* resembles *Pythium proliferum*.

Petersen's argument seems to have been that although his fungus resembled generally the members of the Pythiaceae it was not a species of *Pythium* because the zoospores were fully differentiated before leaving the sporangium: and it was not a species of *Phytophthora* because *Phytophthora* was not known to have proliferating sporangia. On the other hand, although his fungus gave reactions for cellulose in hyphal walls and contents, it could not be placed in either Leptomitaceae or Saprolegniaceae from whose members it differed in many morphological characters. Therefore a new family was required for it, lying somewhere between the Peronosporineae and Saprolegniineae.

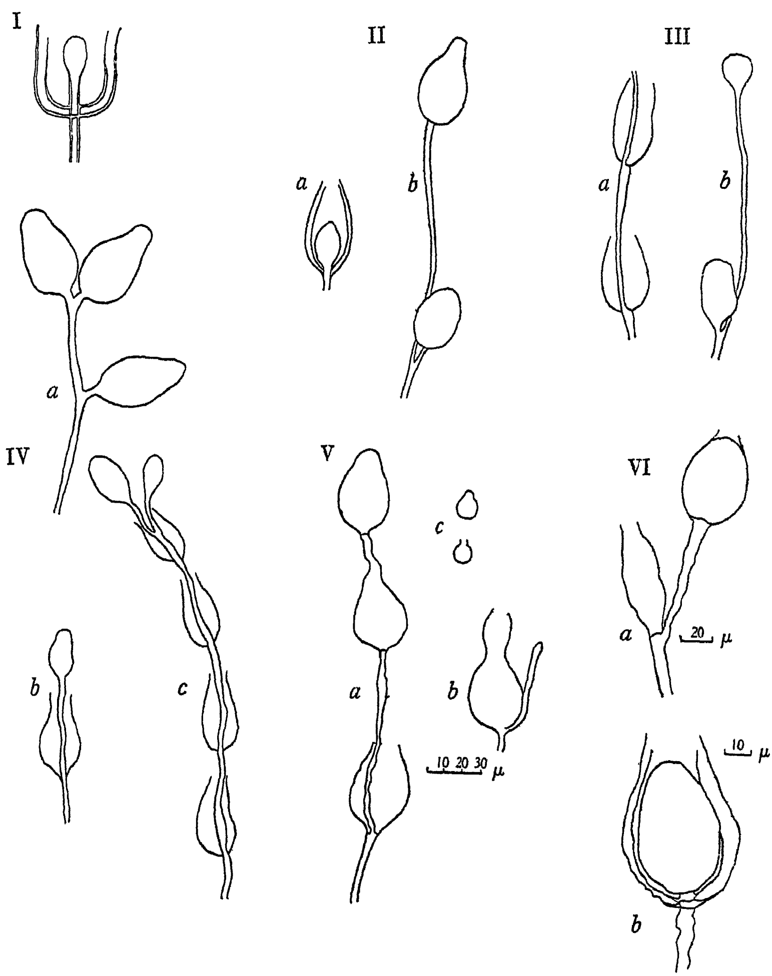
Seven years later von Minden (1916) claimed that he had frequently met with this water mould (which he called *Pythiomorpha 'gonapodioides'* as did others after him), and that he could complete in some respects Petersen's original description. His account agrees with Petersen's except that he reported the emission of zoospores in an ephemeral vesicle, and a single occurrence of sexual organs on a slender mycelium, whose connexion with the sporangium-bearing mycelium he could not establish for certain, though it seemed extremely probable. Von Minden was critical of the establishment of a new family and genus for the new fungus, and pointed out that Petersen did not state his reasons very clearly. He admitted the similarity of the new species to the Pythiaceae in the mycelium, sexual organs, sporangium, and emergence of zoospores, but agreed in the retention of the new family Pythiomorphaceae on the grounds that

the mycelium showed knotted articulations and contained granules which might be the cellulin grains of the Leptomitaceae. In the present state of our knowledge, he said, it was a good idea to give it a place between these two families. Von Minden gave no measurements, and so one cannot be absolutely certain that he was dealing with the same fungus as Petersen.

There are no further records of *Pythiomorpha gonapodyides* until Kanouse (1925) reported it in a collection of water moulds in Michigan. She compared the hyphal growth with that of some species of *Phytophthora* and reported oogonia of an unusual type. Later (1927) she disposed of the family Pythiomorphaceae on the ground that if *Phytophthora* be included in the Pythiaceae, *Pythiomorpha* should be included too. But she still accepted the genus *Pythiomorpha*, stating that it differed from *Pythium* in three characters: absence of 'a tube or specialised beak', zoospores not formed 'in an exterior vesicle', zoospores 'truly diplanetic', and that it differed from *Phytophthora* in its 'diplanetic zoospores, in the absence of any conidial stage, and in its proliferating sporangia'.

Meanwhile, proliferating sporangia, already a well known feature within the genus *Pythium*, had been reported in species of *Phytophthora* by Pethybridge and Lafferty (1919) and by Rands (1922) (Appendix I) (Fig. 1).

At the same time that Kanouse was writing her monograph Buisman (1927) was investigating root rots caused by Phycomycetes. In her report she reviewed the position of the genera *Pythium* and *Phytophthora* and related forms: viz. *Pythiacystis* which had been incorporated in the genus *Phytophthora* by Leonian, and *Pythiogeton* which had been kept as a separate genus. The genus *Blepharospora* she critically examined in relation to *Phytophthora* and suggested that *Blepharospora cambivora* should be re-named *Phytophthora cambivora* on the ground that its chief characteristics, viz. (1) production of sporangia, in mineral salt solutions only and not on solid media, (2) long unbranched sporangiophores ending in one sporangium and proliferating through the empty sporangium, were exhibited by two well-established species of *Phytophthora*. This suggestion has been universally accepted. A similar suggestion that *Pythiomorpha gonapodyides* should be re-named *Phytophthora gonapodyides* on similar grounds has been either ignored or rejected by subsequent authors with the exception of Fitzpatrick (1930), Drechsler (1930 and 1932) and Sparrow (1935). Buisman maintained quite rightly that there was no character which justified the retention of a separate genus. In particular she noted that the reaction of chlor-zinc-iodine on the mycelium described by Petersen produced the same results with '*Blepharospora*'. Again the proliferation of the sporangiophores was a characteristic of both genera. On these grounds she suggested that the genus *Pythio-*



PHYTOPHTHORA

Fig. 1. Formation of new sporangia in *Phytophthora* (outlines traced and here reproduced). I. *P. cambivora* (*Blepharospora cambivora*) (after Petri), ×666. Formation of sporangia by proliferation. II. *P. cryptogea* (after Pethybridge and Lafferty), ×510. (*a*) Formation of sporangia by proliferation. (*b*) Sympodial branching of sporangiophore. III. *P. Richardiae* (after Buisman), ×366. (*a*) Formation of sporangia by proliferation. (*b*) Sympodial branching of sporangiophore. IV. *P. Cinnamomi* (after Rands). (*a*) Sympodial branching of sporangiophore. (*b*) Formation of sporangia by proliferation. (*c*) Formation of sporangia by proliferation and sympodially on the same sporangiophore. V. *P. megasperma* (after Drechsler). (*a*) Formation of sporangia by proliferation. (*b*) Sympodial branching of sporangiophore. (*c*) 'Diplanetism' of zoospores. VI. *P. Fragariae* (after Hickman). (*a*) Proliferation and sympodial branching of sporangiophore. (*b*) Formation of new sporangia by proliferation.

morpha should be merged with the genus *Phytophthora*. At the same time she described a new species of *Phytophthora*, *P. Richardiae*, with non-papillate proliferating sporangia produced only in liquid media, a characteristic which Petersen supposed was diagnostic for *Pythiomorpha*.

During the intervening and ensuing years other collectors of water moulds in various parts of the world, reported forms corresponding to Petersen's *Pythiomorpha gonapodyides*, notably Barnes and Melville (1932), Cook and Forbes (1933) in Britain: Sparrow in Britain and America (1932, 1935, 1936); Crooks in Australia (1937); Lund in Sweden (1934); Cejp (1932) in Prague; Höhnk (1936) in Germany. The measurements of the reproductive organs did not always correspond to those given by Petersen and Kanouse; sex organs were sometimes reported to be frequent although, according to Petersen, von Minden and Kanouse, they were characteristically rare; but the proliferation of the sporangia was always observed and deemed the distinguishing feature of the genus (Appendix II).

Apinis (1929), investigating the water moulds of Latvia, found a species with markedly undulating hyphae and large proliferating sporangia which emitted zoospores fully formed and not in a vesicle. Oospores were not present. He assumed that this fungus was identical with that named *Pythium undulatum* by Petersen (1909) and renamed it *Pythiomorpha undulata*, thus creating a second species in the genus *Pythiomorpha*. He gives no reason for this change. Sparrow (1932) reverted to the original nomenclature. He stated definitely that the change was not justified. Cejp (1932) collected and cultivated *Pythiomorpha* '*gonapodyoides*' and *Pythiomorpha undulata* in the hothouse of the Botanical Garden of the Charles University in Prague. He supported Kanouse in regarding this genus as occupying a unique position with 'diplanetism of zoospores, celluline, absence of a vesicle'. His knowledge that certain species of *Phytophthora* may show proliferation of sporangia did not deter him from recognizing a family Pythiomorphaceae. Lund (1934) found two forms in Denmark which he called respectively *Pythiomorpha undulata* and *Pythium undulatum*, the former 'common in bogs', the latter 'with doubt observed' in one locality.

It is possible that the investigators were not all dealing with the same fungus; that whereas Petersen and Sparrow had a species of *Pythium*, Apinis and Cejp had a species of *Phytophthora* and Lund had both. The distinction between the two genera lies in the mode of emission of the zoospores but it is difficult to tell from Petersen's description whether the 'vesicle' to which he refers is the true pythioid (secondary) zoosporangium or the evanescent vesicle sometimes seen in species of *Phytophthora*.

While investigating diseases of rice seedlings, Ito and Nagai (1931)

described two species of *Pythiomorpha*, viz. *P. Oryzae* and *P. Miyabeana*. They maintain the genus on the grounds given by Kanouse except that they did not find her 'di-planetic zoospores'. But there is nothing in their account in either word or picture to distinguish these fungi generically from *Phytophthora Fragariae* Hickman (1940).

Lund (1934) reported five species of *Pythiomorpha* from bogs in Denmark: *P. gonapodyides*, *P. undulata* and three un-named species. One of these three he suggests might be *P. Oryzae*, another might be *P. Miyabeana*. He did not observe zoospore emergence, but he did see zoospores fully differentiated within the sporangium. All three species have proliferating sporangia, which Lund regards as one of the distinguishing characters of *Pythiomorpha*, the other being absence of typical conidia. Forbes (1935) reported *Pythiomorpha 'gonapodoides'* from near Bristol. She accepted the family Pythiomorphaceae and described oogonia and antheridia of the type of *Phytophthora*. Sparrow (1936) gave the species in a list of water moulds collected by him in the vicinity of Cambridge, England. Höhnk (1936) collected *Pythiomorpha 'gonapodioides'* near Madison, Wis., U.S.A. and near Bremen in Germany. He identified it by its characteristic mycelium 'intramatrical threads distinctly constricted', and 'straight, thin, smooth and unbranched hyphae...developed only extramatrically'. He also observed 'refractive granules, believed to be cellulin'. From the same localities he collected a second form which produced new sporangia by cymose branching. For this he erected a new species *Pythiomorpha Fischeriana*. The fact that this is the typical method of sporangium formation in the genus *Phytophthora* and that Petersen originally established the genus *Pythiomorpha* on the proliferating nature of the sporangia emphasizes the fact that Höhnk's new form was a species of *Phytophthora*.

Critical analysis of the features claimed as diagnostic for the genus *Pythiomorpha*

A careful examination of the published descriptions of the genus *Pythiomorpha* reveals no outstanding feature by which it can claim equal rank with the three well-marked and universally accepted genera of the Pythiaceae.

The characters which have been described as diagnostic for *Pythiomorpha* are here reviewed and each shown to be a character shared with *Pythium* or *Phytophthora* or both of these.

(1) *Proliferation within the sporangium*

Proliferation is a widespread phenomenon in the family Pythiaceae. De Bary (1860) created a species *Pythium proliferum*, and since then several other species of *Pythium* have been shown to bear proliferating

sporangia viz. *Pythium diacarpum* Butler (1907), *Pythium undulatum* Petersen (1909), and four new species described by Drechsler (1930*b*), *Pythium helicoides*, *Pythium oedochilum*, *Pythium polytylum* and *Pythium paligenes*. All four species of *Pythiogeton* occasionally show proliferation (Drechsler, 1932), and eight species of *Phytophthora* have been reported as bearing proliferating sporangia in circumstances inducing a less vigorous growth in connection with a shortage of air (Appendix I) (Fig. 1).

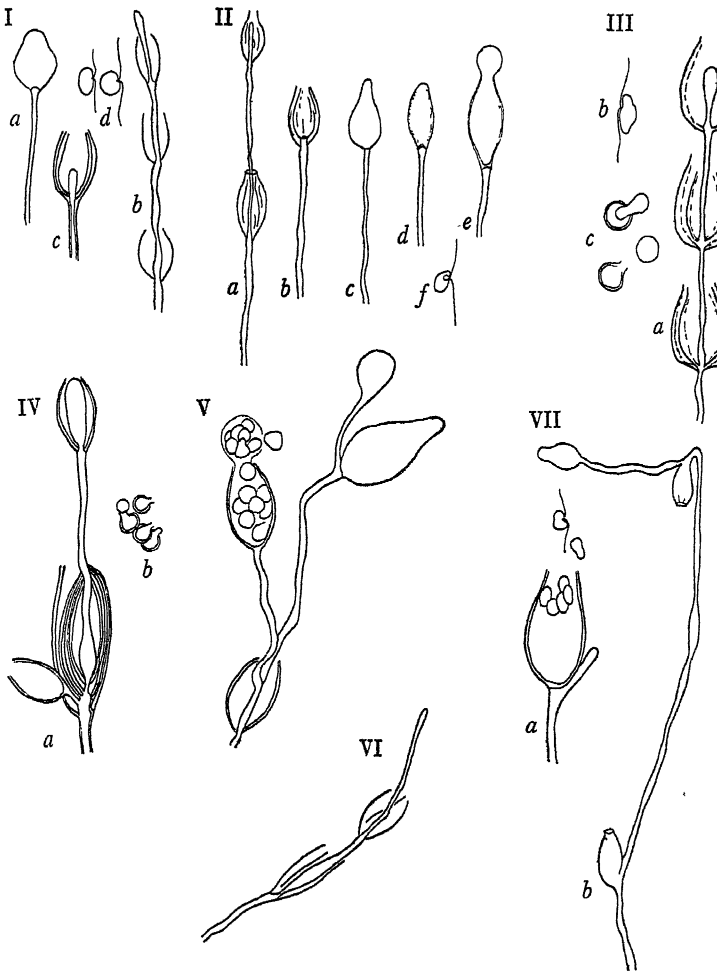
This character then is by no means peculiar to *Pythiomorpha*. Nor is it even a constant feature of *Pythiomorpha*, for Ito and Nagai (1931) published an illustration of both sympodial and proliferating sporangia on one branch of *Pythiomorpha Oryzae*, and Höhnk (1936) went so far as to erect a new species, *Pythiomorpha Fischeriana*, for a form in which 'no proliferation was observed' (Fig. 2). On the other hand it is of interest to note that the most recently erected species of *Phytophthora*, viz. *Phytophthora Fragariae* has proliferating sporangia (Hickman, 1940). The evidence is clearly against proliferation as a character peculiar to *Pythiomorpha* and diagnostic for that genus.

(2) *Emission of zoospores within a vesicle*

All descriptions of *Pythiomorpha* agree that the zoospores are fully fashioned within the sporangium. Von Minden observed an evanescent vesicle but Petersen and others did not. This formation of the zoospores within the sporangium, with rare occurrence of an evanescent vesicle as they emerge, is the character which distinguishes the genus *Phytophthora* from the genus *Pythium*.

(3) *Irregular hyphae*

The intramatrical, irregular-branched mycelium with irregular thickenings of the membrane (Petersen, 1909), knotted, articulated threads (von Minden, 1916), budlike projections (Kanouse, 1925), undulating hyphae (Apinis, 1929), knob-like hyphae (Ito and Nagai, 1931), constricted hyphae (Höhnk, 1936), are all well-known and variable characters of species of *Phytophthora* and *Pythium*. Indeed Petersen (1909) himself erected a species, *Pythium undulatum*, having irregular hyphae. Illustrations of *Phytophthora megasperma* by Drechsler (1931), and of *Phytophthora Fragariae* by Hickman (1940), depict undulating hyphae, although this is not given as a diagnostic feature for *Phytophthora*. Nor can irregular, undulating hyphae be claimed as diagnostic for *Pythiomorpha*. Leonian (1934, Fig. 2) figured six growth forms of *Phytophthora Faberi* to illustrate how variable submerged hyphae can be.



PYTHIOMORPHA

Fig. 2. Formation of new sporangia in *Pythiomorpha* (outlines traced and here reproduced). I. *P. gonapodyides* (after Petersen). (*a*) Typical zoosporangium ($44\mu \times 22\mu$). (*b*) Proliferation of sporangiophore beyond empty sporangium. (*c*) Proliferation of sporangiophore within empty sporangium. (*d*) Zoospores (10μ). II. *P. gonapodyides* (after von Minden). *a–f*. III. *P. gonapodioides* (after Kanouse). (*a*) Proliferation of sporangiophore. (*b*) Zoospore. (*c*) 'Diplanetism' of zoospores. IV. *P. undulata* (after Apinis), $\times 322$. (*a*) Formation of new sporangia sympodially and by proliferation on the same sporangiophore. (*b*) 'Diplanetism' of zoospores. V. *P. Oryzae* (after Ito and Nagai), $\times 430$. Formation of new sporangia sympodially and by proliferation on the same sporangiophore. VI. *P. Miyabeana* (after Ito and Nagai), $\times 430$. Proliferation of sporangiophore. VII. *P. Fischeriana* (after Höhnk). (*a*) and (*b*) Sympodial branching of sporangiophore.

(4) *Microchemical reactions—cellulin grains*

Petersen (1910) wrote: 'By treating with chloroiodide of zinc the membranes of the hyphae adopt exactly the same colour as hygroscopic cotton. The protoplasm within the hyphae is highly refractive with distinct grains. The last-named are coloured yellow by chloroiodide of zinc, but are gradually dissolved by this substance. Hydrate of potassium does not influence them. Presumably they are identical with the grains we find in the Saprolegniaceae and Leptomitaceae and most probably they consist of cellulin.' Von Minden (1916) described the hyphae as having hyaline contents with little granules and on account of these cellulin grains he agrees with Petersen that *Pythiomorpha* must be classed between the Leptomitaceae and the Pythiaceae in a family of its own. Kanouse (1925) agreed that granules are always present, and Höhnk (1936) reported that 'the refractive granules, believed to be cellulin, were also observed; several 2–5, being situated between two neighbouring constrictions'. Others have not referred to these granules, and they appear to be an inconstant feature.

(5) *Absence of conidia*

Kanouse (1925) when augmenting Petersen's description of the genus, described the sporangia as true zoosporangia since they were never seen to function as conidia by the production of germ tubes. Later (1927) she cites the absence of any conidial stage as a feature distinguishing *Pythiomorpha* from *Phytophthora*. Subsequent workers in forming new species of the genus have accepted this and it has been reiterated by Lund (1934) as a diagnostic feature of the genus. Actually the absence of conidia is a feature of growth in water. A conidium in the Pythiaceae is a reproductive body resembling a sporangium in development and in shape, but germinating by a tube to give a mycelium. A conidium may or may not be abstricted from the mycelium. The asexual reproductive body characteristic of the genus *Phytophthora* may function either as a sporangium or as a conidium. It has previously been shown by two of us (1931) that the method of germination depends entirely on conditions such as age of mycelium and age of spore. Experiments have shown that it is primarily a sporangium and that only when frustrated in early production of zoospores, does it germinate by means of a tube. Among the aquatic members of the genus, zoospore production is the rule and conidia are rare; in *Phytophthora megasperma* Drechs. there is no mention of germination by a tube. On the other hand, *Pythiomorpha undulata* has been recorded as having conidial germination. This character cannot therefore be regarded as distinguishing the two genera.

(6) '*Diplanetic*' *zoospores*

This character claimed by Kanouse for *Pythiomorpha gonapodyides* is really the repetitional emergence of Atkinson (1909) and equivalent to the repetitional diplanetism described by Drechsler (1930) for six species of *Phytophthora*. It is a frequent feature of species of Pythiaceae as well as Saprolegniaceae in which latter family true diplanetism occurs, i.e. two unlike swimming forms. This character cannot therefore be regarded as one which would permit its use to distinguish the genus *Pythiomorpha* from either the genus *Phytophthora* or the genus *Pythium*.

(7) *The aquatic habitat*

The four species of *Pythiomorpha* are unquestionably water moulds. Now while species of *Pythium* have frequently been reported in collections of water moulds, species of *Phytophthora* have not. Yet it is a very likely habitat for *Phytophthora*. It is a common practice in the laboratory to induce the formation of sporangia in *Phytophthora* by immersing the mycelium in water, where it produces more slender hyphae, no typical conidia, but sporangia instead; and in the following species these tend to proliferate so that any of them might pass for *Pythiomorpha*: *Phytophthora megasperma*, *P. cryptogea*, *P. Richardiae*, *P. cambivora*, *P. Cinnamomi*, *P. Drechsleri*, and *P. Fragariae*. The drawings of the sporangia of *Pythiomorpha* by Petersen, von Minden, Kanouse and others (Fig. 1) suggest that it was not always the same species that was found growing in water.

Had Ito and Nagai not found their parasites on rotted rice seeds and seedlings in water, it is possible that the proliferating sporangia would not have been so much in evidence and the fungi would have been identified as species of *Phytophthora*. *Phytophthora megasperma* is well known as a parasite on plants in swampy ground. Does it live on in the water as a saprophytic water mould and is it transferred by water, and is that how it came to be collected by Dr Hall among water moulds? It seems that this must be one of the ways in which the diseases caused by species of *Phytophthora* are spread. It is generally recognized that some of the species of *Phytophthora* frequently infect plants in swampy ground, e.g. *P. megasperma* (Drechsler, 1931; Dowson, 1934; Tomkins, Tucker and Gardner, 1936) and *P. Richardae* (Buisman, 1927). It will also be remembered that the two species of *Pythiomorpha* isolated by Ito and Nagai (1931) were vigorous parasites, a feature not previously reported for *Pythiomorpha*. And if, as we firmly believe, the other three species are really parasitic members of the genus *Phytophthora* growing saprophytically in water, pathologists should now regard these water moulds as widespread and forming hitherto unsuspected sources of infection.

Conclusion

We claim then that there are no grounds for the retention of the genus *Pythiomorpha*. Petersen founded his new genus and species on the proliferating sporangia, the growth-form of the hyphae, and the presence of 'cellulin' grains in the thallus. Other diagnostic characters given by later workers are the aquatic habit, the diplanetic zoospores and the absence of true conidia. It seems likely that if Petersen had known (*a*) that species of *Phytophthora* could live saprophytically in water as water-moulds, and (*b*) that several species of *Phytophthora* bore proliferating sporangia (Appendix I), he might not have felt the need for a new species. After all he did name it *Pythiomorpha*, and said 'This species resembles *Pythium proliferum*.'

Moreover all these characters, except the presence of 'cellulin' grains, are commonly exhibited by a group of species of *Phytophthora*. But since there are species of *Pythiomorpha* without 'cellulin' grains, these can hardly be taken as the one diagnostic feature. It may however be claimed that while the characters of the genus *Pythiomorpha* are shared by various species of *Phytophthora*, *Pythiomorpha* is distinct in possessing *all* of them. But this is not so. *Phytophthora megasperma* possesses all of them (except for the variable cellulin grains). It might also be claimed that as we have not handled a bona-fide species of *Pythiomorpha* we are not in a position to appreciate its distinctive character (if indeed it has any), which justifies the retention of a separate genus. We have however handled four different isolations all identified as and claimed to be *Pythiomorpha gonapodyides*. One turned out to be *Phytophthora megasperma*, one a species of *Pythium* and the other two (from different countries) certainly species of *Phytophthora*, probably *P. cryptogea*. All this serves to emphasize the point we have tried to make, viz. that there has never been a bona-fide genus *Pythiomorpha* but that all the fungi described under this head have been different species of *Phytophthora* growing in water. If collectors have been examining different species of *Phytophthora* the discrepancies in descriptions found in the literature are explained (Appendix II). It is unfortunate that the early strains, those of Petersen, von Minden and Kanouse, are lost.

We feel we have collected together enough evidence to endorse the statements made by Buismann (1927), Fitzpatrick (1930), Drechsler (1930 and 1931), and Sparrow (1935) regarding the invalidity of the genus and recommend that no further species be created, that the five species already erected be re-examined and if not found to be known species of *Phytophthora* (or *Pythium*) that they be incorporated as new species into one or other of these well established genera. The collection of numerous examples of the so-called species of *Pythio-*

morpha from a variety of aquatic habitats and their incorporation into the genus *Phytophthora* (or *Pythium*), even their identification with existing species, will finally confirm our claim about which there can be no reasonable doubt.

Summary

A water mould collected on an apple in a pond near Manchester was identified as *Pythiomorpha gonapodyides* and obtained in pure culture.

In pure culture it was identified as *Phytophthora megasperma*.

This led to a survey of the descriptions of various forms and species of *Pythiomorpha* recorded between 1909 and 1936 and the discovery that each would answer to a species of *Phytophthora* growing in water. The descriptions of the original species *Pythiomorpha gonapodyides* varied so much as to suggest more than one species of *Phytophthora*.

This led to an enquiry into the diagnostic features of *Pythiomorpha gonapodyides* Petersen, and the discovery that all of these were equally characters of the Pythiaceae as a whole, i.e. there was no peculiar generic or indeed specific character.

It then appeared that there were no records of species of *Phytophthora* occurring as water moulds except a tentative one of *P. cryptogea* and the present one of *P. megasperma*. Nevertheless it was clear that several workers had already felt that the species of *Pythiomorpha* were probably species of *Phytophthora*, and the present study brings facts and illustrations in support of their conviction that the genus *Pythiomorpha* is invalid.

Grateful acknowledgements are due to Dr M. P. Hall for kindly sending the isolated strain to the laboratory of Royal Holloway College, to Mr S. F. Ashby and Dr Tucker for identifying the organism as *Phytophthora megasperma*.

We should like to thank Dr Leonian for a letter expressing his whole-hearted agreement that the genus shall be suppressed, and Mr S. F. Ashby for his support of our views.

While carrying out this enquiry (a side line of our other researches) one of us has been in receipt of a grant from the Department of Scientific and Industrial Research which is here gratefully acknowledged.

APPENDIX I

Species of Phytophthora *having proliferating sporangia*

Sporangia: Length	Sporangia: Breadth	Sporangia: Mean or average	Species	Oospores: Range	Oospores: Mean or average	Oospores: Colour
60–75 μ	40–54 μ	67 × 47 μ	*P. cambivora* (Petri) Buisman after Petri (1918)	20–27 μ	23·5 μ	Sooty
24–50 μ	17–30 μ	40 × 27 μ	*P. cryptogea* Pethybr. & Laff. after Pethybr. & Laff. (1919)	Very rare	25 μ	Yellowish
25–100 μ	18–43 μ	57 × 33 μ	*P. Cinnamomi* Rands			
			after Rands (1922)	None		
			after Ashby (1929)	Very rare	27·2 μ	
			after Tucker (1931)		25·7 μ	
Variable			*P. Richardiae* Buisman			
			after Buisman (1927)		29 μ	Oogonium yellow; Oospore greenish purple
			after Tucker (1931)		25·4 μ	Colourless
			P. megasperma Drechsler			
15–60 μ	6–45 μ	37·5 × 25·5 μ	after Drechsler (1931)	11–54 μ	41·4 μ	
31–69 μ	18–42 μ	52 × 35·7 μ	after Blackwell, Waterhouse & Thompson	22–40 μ	38 μ	Yellow
41·6–56 μ	28–40 μ	49·4 × 33·6 μ	after Tomkins, Tucker & Gardner (1936)	26–40 μ	33·4 μ	
24–38 μ	15–24 μ	31·4 × 21 μ	*P. Drechsleri* Tucker after Tucker (1931)	16·7–45 μ	25·6 μ	Hyaline to lemon
32–90 μ	22–52 μ	60 × 38 μ	*P. Fragariae* Hickman after Hickman (1940)	22–44 μ	33 μ	Oogonium golden brown with age

Phytophthora erythroseptica should be included in this table. (Buddin, W. "Root rot, shoot rot and shanking of tulip caused by *Phytophthora cryptogea* Pethybr. & Laff. and *P. erythroseptica* Pethybr., *Ann. appl. Biol.* xxv, 1938, pp. 705–29.)

APPENDIX II

Records of species of Pythiomorpha

Sporangia				Oospores		
Length	Breadth	Mean or average	Species	Range	Mean or average	Colour
			P. gonapodyides Petersen			
		44 × 22 μ	after Petersen (1909)		None	
No measurements			after von Minden (1915)		Few, doubtful origin	
26–48 μ	16–27 μ	37 × 21·5 μ	after Kanouse (1925)	22–36 μ	29 μ (Oogonia)	
			after Forbes (1935)		30 μ	Dark brown
		45 × 22 μ	after Lund (1934)		None	
		46 × 28 μ	after Höhnk (1936)		None	
			P. undulata (Petersen) Apinis			
50–167 μ	20–52 μ	108·5 × 36 μ	after Apinis (1929)		None	
45–117 μ	35–43 μ	70 × 40 μ	after Lund (1934)		None	
			P. Oryzae Ito & Nagai			
41–84 μ	26–48 μ	72 × 36 μ	after Ito & Nagai (1931)		None	
			P. Miyabeana Ito & Nagai			
36–53 μ	17–36 μ	47 × 26 μ	after Ito & Nagai (1931)	24–36 μ	30 μ	Yellowis
			P. Fischeriana Höhnk			
		46 × 28 μ	after Höhnk (1936)	20–28 μ (Oogonia)		
			Unnamed species Lund			
50–75 μ	35–52 μ		after Lund (1934)		None	
67–103 μ	42–56 μ		"		None	
40–67 μ	30–42 μ		"		None	

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(*Accepted for publication* 21 *March* 1941)

FURTHER NOTES ON BRITISH HYPOCREALES

By T. PETCH

Since the publication of *British Hypocreales* in *Trans. Brit. myc. Soc.* XXI (1938), 243–305, several species have been added to the British list. These are recorded below, with further information concerning some of the rarer species previously recorded for this country.

Melanospora vitrea (Corda) Sacc.

In *J. Bot.* July 1936, p. 189, I published a note on this species, pointing out that Corda's fungus, *Sphaeronaema vitreum*, was a *Sphaeronaemella*, as then understood, and distinct from *Sphaeronaemella blepharistoma* Berk. I find that von Höhnel had previously considered these species, and had published a preliminary note in *Oesterreich. bot. Z.* Jahr. 1916, p. 96, in which he gave the name of a new genus, *Hyalopycnis*, with the species, *H. vitrea* (Cda.) v. H., *H. blepharistoma* (Berk.) v. H., and *H. hyalina* v. H. In *Hedwigia*, LX (1918), 151, von Höhnel further discussed these species. He had rejected the name *Sphaeronaemella*, on the ground that the type species of that genus was an ascomycete.

The three species named have the same structure. They resemble a *Melanospora* in shape, being globose below, with a long, cylindrical neck, but, except in the centre of the base, the wall is composed of vertically parallel, hyaline hyphae, fused laterally. Von Höhnel examined the type specimens of *H. blepharistoma*, and decided that it differed in shape from *H. vitrea* and was a distinct species. I redescribed it (*loc. cit. supra*) from fresh specimens. The evidence regarding *H. vitrea* is not altogether satisfactory, as no one has been able to find in recent specimens assigned to that species the peculiar spores described and figured by Corda. He stated that they were oval when viewed laterally, but quadrangular in section. von Höhnel suggested that what Corda saw were chlamydospores, but even so they have not been reported again.

In *Notices of British Fungi*, No. 196, Berkeley stated that he had found *S. blepharistoma* not only on *Russula adusta*, but also on nettle roots. I have specimens collected at North Wootton on decaying stalks of *Brassica* and Hollyhocks which resemble that species, but the spores are larger, $9–16 \times 5–9\,\mu$, sometimes cylindrical or fusoid, $10–16 \times 2–3{\cdot}5\,\mu$, and the fungus appears to be another species of *Hyalopycnis*.

It may be noted that the type species of *Sphaeronaema* Fr. (1823), *S. subulatum*, has spores furnished with a cilium at the apex and a pedicel at the base. *S. oxysporum* Berk. is the same species. No other similar fungus has been recorded, and consequently *Sphaeronaema* is a monotypic genus belonging to the Nectrioidaceae. The name *Eleutheromyces* was given to an alleged ascosporic stage of *S. subulatum*, and it does not replace *Sphaeronaema*.

Sphaeronaemella

The genus *Sphaeronaemella* was instituted by Karsten in *Hedwigia* (1884), No. 2, with the description, Spermogonia subsphaeroid, membranous, very thin, soft, horny when dry, superficial, glabrous, light-coloured, with a rostellate ostiolum; extruded spores ellipsoid, continuous, forming a globule at the apex of the rostrum. No colour was given for the spores, but the type species, *S. Helvellae*, which occurred on *Helvella infula*, was said to have hyaline spores and a yellowish pycnidium, 120 μ diameter, or 150 μ high and 135 μ wide, with a hyaline beak, 0·3–0·5 mm. high and 20–35 μ diameter, penicillate at the apex. Saccardo entered it as a pycnidial fungus, as described, and it has been so interpreted by later mycologists. The name was used in that sense in *British Hypocreales*, p. 301.

In *Hedwigia*, LX (1918), 151, von Höhnel recorded that Diedicke had examined the type of *Sphaeronaemella Helvellae* and found that the wall of the globose base was parenchymatous, while that of the beak was composed of long-fibred tissue, and that there were no conidiophores. Von Höhnel therefore decided that it was an ascigerous fungus with diffluent asci, similar to *Ceratostomella*, but belonging to the Hypocreaceae. It is similar in shape to *Melanospora*, but has hyaline spores. He also placed *Sphaeronaemella fimicola* March. as a similar ascomycete. The last-named was recorded for Britain by Massee and Salmon on horse dung, and by Massee and Crossland on rabbit dung. Its description, *ex* Saccardo, is included here for reference.

Sphaeronaemella fimicola March. Perithecia scattered, rarely gregarious, superficial, globose, 150–250 μ diameter, membranous, soft, yellowish, glabrous, produced into a subulate, cylindrico-conoid beak, 700–820 μ long, hyaline and penicillate at the apex; spores ellipsoid, hyaline, slightly curved or straight, 7–7·5 × 2–2·5 μ, involved in mucus, forming a white ovoid globule, 130 × 85 μ, at the apex of the ostiolum. On dung.

Melanospora cirrhata Berk.

In *J. Bot.* LXXIII (1935), 224, I wrote 'Berkeley issued specimens in *British Fungi*, No. 325 (1843) as *Melanospora cirrhata*, but he did not publish a description. Subsequently, he decided that his

species was the same as *M. Zamiae* Corda, and placed that name on some of the specimens in his herbarium.' It was also stated that Corda's species was unknown, whereas it had already been re-identified by Mr E. W. Mason and described by him in *Annotated Account of Fungi received at the Imperial Mycological Institute*, List II, fasc. 2 (1933). After further examination of recent specimens of *M. Zamiae*, I am of opinion that Berkeley's view was correct, and that *M. cirrhata* is a synonym of *M. Zamiae*. *Gibsonia phaeospora* Massee is no doubt the same species.

NECTRIA DITISSIMA Tul.

Tulasne first found his *N. ditissima* on beech. In his account of it he stated that it was '*N. coccinea*', the form that occurred on beech, and that to it belonged, at least in part, the *Sphaeria coccinea* of most writers on mycology, his list including Moug. & Nestler, *Stirp. Vog. Rhen.*, fasc. II, 1811, No. 180 (on bark of *Fagus*), Desmazières, *Pl. Crypt. France*, ed. 1, fasc. VIII, 1829, No. 380 (on thick bark of *Fagus*), and Currey in *Trans. Linn. Soc. Lond. Bot.* XXII, 282, No. 175, pl. 49, fig. 174.

Desmazières, No. 380, in Herb. Kew., is certainly *N. coccinea*, not *N. ditissima*; it has an evident ostiolum, the cells of the wall are comparatively large, and the apex of the ascus is truncate and thickened, with a pore. Moug. and Kestler, No. 180, has the apex of the ascus rounded, the spores uniseriate below, biseriate above, oval or narrow oval, $9–18 \times 5–6\,\mu$, and somewhat persistent, septate, branched paraphyses; this is *Dialonectria galligena*.

Currey's figure of the ascus shows a rounded apex and obliquely uniseriate spores, and is not that of *N. coccinea*. He stated: 'I am uncertain whether this is the true *coccinea* Pers. This plant and the var. *sanguinella* are named by Mr Berkeley.' The only specimen of '*Nectria coccinea*' in Herb. Kew. *ex* Herb. Currey is an American one marked '*Nectria coccinea* on apple. Mass.', but this is *N. cinnabarina* and does not agree with Currey's figure.

Phillips and Plowright recorded *N. ditissima* in *New and Rare British Fungi*, no. 154, March 1880, without host, date, or locality. Plowright's paintings of the fungus on canker in apple trees, King's Lynn, March 1884, now in Herb. Brit. Mus., are of *Dialonectria galligena*.

NECTRIA INUNDATA Rehm apud Weese

This species was described by Weese in *Z. Gärungsphys.* I (1912), 146, from specimens 'auf Wasserbretten aus Tannenholz'. Rehm had named it in herb., but had not published a description. After the description Weese stated that he had also found it on wood of *Prunus Padus* in Berkeley's herbarium at Kew. He did not cite any collection number, date, or locality, and I did not find the specimen in the Kew

herbarium. Consequently, as it was uncertain whether it was British, it was omitted from *British Hypocreales*. The description is quoted here for reference.

Perithecia scattered, base generally somewhat immersed, globose to globoso-conoid, up to 300 μ diameter, often collapsing when old, blood-red to dark red-brown, shining, smooth, rarely with a few projecting, thick-walled, short, brown hyphae, with a darker, usually almost black, hemispherical papilla up to 110 μ high, 150 μ broad, which is composed of parallel, thick-walled hyphae; asci clavate to almost cylindrical, truncate above, almost sessile, $85–100 \times 11–14\,\mu$; ascospores ellipsoid to subfusoid, generally inequilaterally curved, ends rounded, hyaline becoming brown, smooth, one-septate, often slightly constricted, 13–20 (sometimes 24) $\times 5{\cdot}5–7\,\mu$.

In a later note, *S.B. Akad. Wiss. Wien, Math.-naturw. Klasse*, Abt. I, Bd. cxxv (1916), 507, Weese stated that because of its brown spores the fungus belonged to the genus *Letendraea*.

NECTRIA OCHROLEUCA (Schw.) Berk.

Additional localities for this species are provided by specimens in Grove's herbarium. These are, on bark, Selly Oak, December 28, 1909; on a stump, Coleshill, September 8, 1886; and on seeds of horse chestnut, Birmingham, September 11, 1886. In the last-named specimen, the perithecia are accompanied by a conidial stage, which may take an isarioid form, white, about 0·5 mm. high, usually expanding fanwise from the base and terminating in a tangle of conidiophores, or a stilboid form, 0·5 mm. high, with a yellow pruinose stalk, 0·2 mm. diameter, and a white head, 0·3 mm. diameter. The conidiophore has a stout main stem, 4 μ diameter, dividing above, each branch terminating in a small cluster of phialides, as in Seaver's figure of the conidiophore of *Creonectria seminicola*, which, according to von Höhnel and Weese, is the same as *N. ochroleuca*. The conidia are oblong or oval, $5 \times 2\,\mu$ or $4 \times 3\,\mu$. Seaver gives the conidial stage of *N. ochroleuca* as *Verticillium tubercularioides* Speg., after examination of the type of the latter. *Nectria Hippocastani* Allesch., described from specimens on rotting seeds of horse chestnut, is not this species, judging from its description.

Nectria polyporina Petch, n.sp.

Perithecia caespitose, in dense clusters on an inconspicuous stroma, brick-red becoming dark red, appearing smooth, but minutely rugose when magnified, ovoid, 0·15 mm. diameter, 0·25 mm. high, apex conico-discoid or truncate when mature; asci clavate, apex truncate, $54–63 \times 9\,\mu$, spores biseriate; paraphyses diffluent; ascospores usually fusoid, rarely narrow oval, one-septate (some two-septate), hyaline, verrucose, $12–15 \times 4{\cdot}5\,\mu$ (one spore, $21 \times 4\,\mu$). On the upper surface

of old *Fomes annosus*, the stromata emerging through cracks in the crust, North Wootton, August 10, 1936.

Peritheciis caespitosis, stromate inconspicuo, primo lateritiis dein fusco-rubris, levibus, sub lente minute rugosis, ovoideis, 0·15 mm. diam., 0·25 mm. alt., apice conico-discoideo v. truncato; ascis clavatis, apice truncato, 54–63 × 9 μ, sporis biseriatis; paraphysibus diffluentibus; ascosporis saepius fusoideis, raro angusto-ovalibus, uniseptatis (interdum biseptatis), hyalinis, verrucosis, 12–15 × 4·5 μ.

Dialonectria applanata (Fuckel) Petch, *comb. nov.*

Fuckel described this species as *Nectria applanata* in *Symbolae Mycologicae*, Nachtr. 1 (1871), 310. There are specimens in Grove's herbarium, 'on the remains of a sphaeriaceous fungus', Driffold Lane, 27 April 1882, and 'on a *Eutypa*', Blackwell, 22 March 1884; and I have others, on an effete pyrenomycete on sycamore, Steeton, Tadcaster, 19 April 1936 (W. G. Bramley), and on *Rhamnus catharticus*, Wheatfen Broad, 11 April 1940 (E. A. Ellis). The pycnidial stage, *Stylonectria applanata* v. Höhnel, was collected in May 1938 in Guiting Wood on *Diaporthe decedens* on hazel.

The perithecia are scattered or clustered, globose or oval, about 0·1 mm. diameter, typically with a flat apical disk which projects slightly over the body of the perithecium, bright red, becoming blood-red or almost black, subtranslucent, sometimes collapsing laterally; the asci are cylindrical, truncate, 70 × 4 μ, with uniseriate spores, and the ascospores oval or oblong-oval, smooth, hyaline becoming yellow, one-septate, 5–9 × 3–4·5 μ. The pycnidia are similar in shape and size, and the pycnospores resemble the ascospores, but are larger, 9–12 × 4–4·5 μ. In the available specimens, the pycnidia are more definitely applanate than the perithecia, the apex of the latter varying from discoid to conico-discoid or broadly conoid. This species may be passed over at first as *Dialonectria sanguinea*, but the smaller ascospores should arouse suspicion.

Dialonectria flammeola (Weese) Petch, *comb. nov.*

Weese described this species, as *Nectria*, in *Z. Gärungsphys.* 1 (1912), 142. There is a specimen in Grove's herbarium, 'on bark of *Latania borbonica*, Sutton (D.L.), 21. 2. 1888'. *Latania borbonica* is a commonly grown pot palm, the correct name of which is *Livistona sinensis*. *Dialonectria flammeola* belongs to the *Nectria haematococca* group, common saprophytic species in the tropics under many names, but it was originally described from European specimens on *Populus canadensis*. It is not known whether the present specimen grew in a greenhouse. The perithecia are superficial, scattered or gregarious, yellowish red, pruinose or minutely rugose, globose with a small conical ostiolum or globoso-conoid, 0·18 mm. diameter, sometimes

collapsing centrally, the outer layers of the wall consisting of red-brown, polygonal cells, up to 40μ wide, with tangentially elongated cells round the ostiolum. The asci are clavate, 50–66 × 4–7μ, with a truncate apex, and spores obliquely uniseriate, or uniseriate below and biseriate above. The ascospores are oblong-oval, hyaline, one-septate, smooth, 7–13 × 2·5–4μ.

DIALONECTRIA GALLIGENA (Bres.) Petch

A specimen on ash, from Wells, Somerset, April 1938, was kindly sent me by Professor F. T. Brooks. The perithecia are on a canker on a twig about 5 mm. diameter.

NECTRIELLA CHRYSITES (Westend.) Sacc.

This species was recorded by Grove in *J. Bot.* XXIV (1886), 133, from specimens on twigs and small branches of ash, Middleton (Warwickshire), April, but he stated, 'It is not without a little uncertainty that I refer my specimens to this species, since the asci were imperfectly developed.' The identification was not correct.

LASIONECTRIA LECANODES (Ces.) Petch

An additional locality for this species is Scolt Head Island, where it was collected on 30 May 1936, on *Peltigera polydactyla* by Mr E. A. Ellis.

LASIONECTRIA LEPTOSPHAERIAE (Niessl) Petch

Specimens of this species were collected by Mr E. A. Ellis at Pool Carr, Wheatfen Broad, Norfolk, 19 December 1940, on *Leptosphaeria doliolum* on nettle.

HYPHONECTRIA SOLANI (Reinke & Berth.) Petch

This species was included in *British Hypocreales* on a record by Pethybridge from Ireland. There is a specimen in Grove's herbarium, on rotting potato, Shirley, Warwickshire, 29 April 1914. The subiculum is scanty, white or ochraceous, and the perithecia are scattered or clustered, obpyriform, straight, or curved above, red to purple-red with a yellow obtuse apex, 0·5 mm. high, 0·25 mm. diameter, with spreading hyphae on the lower half and a few short, rigid, two-septate hairs, about 25 × 5μ. The crown figured by Reinke and Berthold on the apex of the perithecium was evidently a mass of extruded spores. The asci are cylindrico-clavate, 90 × 9μ, with a truncate apex, and the paraphyses are linear. The ascospores are uniseriate, oval or oblong-oval, smooth, hyaline, then pale yellow and minutely warted, one-septate, not constricted at first, slightly constricted when old, 12–18 × 6–8μ, ends not pointed, with some globose, continuous, 7μ diameter.

Hyphonectria violacea (Schmidt) Petch

This was recorded by Grove in *J. Bot.* xxiii (1885), 132, under the synonym, *Hypomyces candicans*, on *Stemonitis fusca*, Trickley Coppice, Warwickshire, September 1884. Examination of the specimen in Grove's herbarium shows that the identification was correct. The ascospores are oval or oblong-oval, ends rounded, one-septate, sometimes rough, 6–7 × 2 μ. The fungus has the general appearance of the common hyphomycete on *Stemonitis* and other myxomycetes, *Cephalosporium verticicolum* Petch, but that species has not been found in company with the perithecia of *Hyphonectria violacea*, and its conidia do not agree with those described by Tulasne for the latter. *H. violacea* was originally described on *Fuligo septica*, but it is evidently not confined to that host, and, from their descriptions, it would seem probable that *Hypomyces exiguus* Pat., on *Stemonitis*, spores 3–4 × 2 μ, *Nectria Rexiana* Ellis, on *Chondrioderma spumarioides*, spores 5–6 × 1·5–2 μ, and *Hyphonectria Raciborskii* Penz. & Sacc., on *Physarum didermoides*, spores 6·5–7·5 × 3 μ, are the same species.

Apiocrea chrysosperma (Tul.) Syd.

A perithecial specimen of this, on a *Boletus*, Coleshill Pool, 13 September 1894, in Grove's herbarium, has ascospores, 18–30 × 4–6 μ. It is thus the long-spored form.

Hypomyces aurantius (Pers.) Tul.

In *British Hypocreales* the name *Diplocladium penicillioides* Sacc. was adopted for the conidial stage of this species. In a sense, that was correct, for it is the name given by Saccardo to Cooke's figure of the conidial stage in Plowright's *Monograph of the British Hypomyces*. Saccardo, in his description of *H. aurantius*, stated that the conidial stage was *Diplocladium minus* Bon. or a closely allied species, but I discarded that name in view of Massee's statement that *D. minus* occurred on trunks. *D. minus*, however, was originally described as occurring on old polypori, and it is frequent in this country on that substratum.

The mycelium of *H. aurantius* may be white at first, becoming ochraceous or orange, or it may remain permanently white and bear pale honey-coloured perithecia. On further consideration it seems clear that *D. penicillioides* is *D. minus*, and that *D. melleum* (B. & Br.) Sacc. is the same species. Berkeley and Broome stated that *D. Rennyi* was very near *D. minus*, and Massee placed it as a synonym of the latter. No host was given for *D. Rennyi* by Berkeley and Broome, but in Saccardo, *Sylloge Fungorum*, it is said to occur on trunks. Mr E. W. Mason has kindly examined the type collection and has

informed me that one envelope contains bark and wood, but there does not appear to be any hyphomycete in that envelope.

RHYNCHONECTRIA LONGISPORA (Phil. & Plowr.) v. Höhnel

Phillips and Plowright described this species as *Eleutheromyces longisporus* in *New and Rare Fungi*, No. 289, 'Perithecia crowded, superficial, elongated, whitish yellow, 450–500 μ high by 200 μ wide at the base; ostiola acutely pointed; asci clavato-elongate or subfusiform, 130–150 × 20–25 μ, usually tetrasporous; sporidia hyaline, elongate fusiform, acute, uniseptate, with terminal cilia at both extremities, 50–60 × 5–8 μ. On the remains of some myxogaster. Holt House Woods, King's Lynn, 4th Sept., 1882. The acute ostiola are composed of a number of converging narrow straight cells placed side by side.' In Plowright's note-book the host is given, with a query, as *Cribraria argillacea*, and there is the entry, 'sketched', but the sketch, unfortunately, is not among his papers. It may have been sent to Phillips, but it was not published.

In *J. Bot.* 1907, p. 171, Grove recorded the occurrence of *Eleutheromyces longisporus* on the decaying plasmodium of a myxomycete, and placed it in a new genus as *Eleutherosphaeria longispora* (Phil. & Plowr.) Grove. But before that, in 1902, von Höhnel, acting on a suggestion by Saccardo in *Syll. Fung.* IX, 942, had instituted for it a new genus *Rhynchonectria*. Von Höhnel did not have a specimen.

Grove stated that the perithecia occurred in globular or discoidal masses, 0·25–0·5 mm. diameter, twenty to fifty in a cluster, their bases immersed in a slight layer of mucus and the long necks protruding in all directions. The perithecia were hyaline and whitish, faintly tinged yellow when older, globular or ellipsoid below, prolonged into a tapering neck; the venter was composed of large pseudoparenchyma, with cells 10 μ diameter, the cells becoming elongated upward, and reduced at the apex to six or eight narrow linear cells surrounding the orifice, the apex being as sharp as a needle but soon breaking off. The wall was one cell thick, except at the base. The perithecia were 400–500 μ high and 60–90 μ diameter below. The asci were clavato-fusiform, four-spored, 120 × 25 μ, soon diffluent, and the spores fusiform, acute at each end, hyaline, uniseptate, 60–70 × 8–10 μ, surrounded by a layer of mucus which holds the spores together after the diffluence of the ascus.

Grove noted that the perithecia in his specimen were not so broad, nor were the spores ciliate at both ends, as described by Plowright. He suggested that the mucus when dried might present the appearance of a cilium at the ends. That suggestion may be correct, for Plowright's first draft of the description is 'spores fusiform, lower end most attenuated, almost into a cilium'. It may be noted that Grove's figure *b* exactly resembles the cluster of spores in *Mycorhynchus*. In

reply to my query, Mr Grove informed me that there was no specimen of *Eleutheromyces longisporus* in Plowright's herbarium, and said he thought it would be impossible to preserve it dry.

If the spores of *Rhynchonectria* are really not ciliate, there does not appear to be anything to distinguish it from *Treleasia* Speg. (1896). Spegazzini figured the ascus of *Treleasia Sacchari*, the type species of the genus, as limoniform, i.e. broadly ellipsoid, with an apiculus at each end, and resembling Grove's fig. *b*. Unfortunately, Petrak and Sydow, who examined the type specimen, could not find any trace of the fungus on it now (*Ann. Myc.* XXXIII (1935), 166). The same is true of the types of *T. musicola* Speg. and *Copranophilus spinuliformis* Speg., the latter the type of a new genus which does not appear distinct from *Treleasia*.

All the foregoing fungi have a remarkable resemblance to *Mycorhynchus* Sacc. (1905). They have the same type of perithecium and the same kind of spores, but the spores are said to be in asci, whereas *Mycorhynchus* is regarded as a pycnidial fungus. A note on the resemblance of *T. Sacchari* to *M. Marchalii* was published in *Ann. Myc.* XXXIV (1936), 74, 75.

A fungus which appears to be *Mycorhynchus Marchalii* (Sacc.) Sacc. & D. Sacc. was collected at North Wootton, June 1935, on decaying stalks of *Brassica*. The pycnidia are clustered, superficial on, or partly embedded in, a delicate plectenchymatous pale brown stroma, from which they radiate in all directions, forming subglobose tufts up to 0·5 mm. diameter, or smaller and confluent in extended patches. The pycnidia are hyaline, elongated flask-shaped, with a venter 66 μ high, 40 μ diameter which merges into a long beak, up to 300 μ high, 25 μ diameter below, attenuated upwards to a point. The wall of the venter is membranous, parenchymatous, while that of the beak is composed of parallel hyphae, 4 μ diameter below, septate, fused laterally. The spores are fusoid, attenuated below, sometimes into a thin appendage, hyaline, centrally one-septate slightly curved, 40–63 × 6–7 μ, with a mucilaginous coat which swells up enormously in lacto-phenol. There is sometimes an obscure septum at the base of the spore, which may indicate that the appendage is, in part, a sporophore. The spores appear to be almost sessile on the base of the pycnidium. They emerge separately from the pycnidium, but after extrusion they frequently adhere side by side in clusters of two or four. *Mycorhynchus Marchalii* was said to have smaller pycnidia, longer and narrower spores (65–70 × 5·4–5·6 μ), and no mention was made of a stroma.

From the foregoing data it will be seen that several questions arise which cannot be decided until further material has been collected. Was Grove's fungus the same as Plowright's? Except for the ascus, Grove's description is good for *Mycorhynchus*. Are *Rhynchonectria* and *Treleasia* ascomycetes? It would appear from Plowright's and

Grove's observations that the former is, though neither states how the four spores are arranged in the ascus. *Treleasia* is much more doubtful, judging from the figures.

Calonectria xantholeuca (Kunze) Sacc.

This species was originally described as *Sphaeria xantholeuca* in Fries, *Syst. Myc.* II, 503, 'Sparsa, peritheciis erumpentibus conico-subrotundis albo-lutescentibus, villo delicato albido tectis. Minuta, mollis, subpellucida, ut videtur astoma et globifera. In caulibus Epilobii, Helvetiae.' It was redescribed by Karsten in *Symbolae ad Mycologiam fennicam*, II, 241, and it is the latter description which was taken up by Saccardo in *Syll. Fung.* II, 547. Karsten described the ascospores as two- to four-guttulate; hence Saccardo assumed that they would ultimately be one- to three-septate, and accordingly entered the species as *Calonectria*. But in numerous other similar cases in which Saccardo made that assumption the fungus has been found to be a *Nectria*, and consequently the true position of this species is doubtful, even if we grant that Karsten had Kunze's fungus. Karsten's specimens were on dried stems of *Trifolium medium*. The description appears to indicate a *Nectriella*, and, as Weese has suggested, it may be the same as *Nectriella Sambuci* (v. Hoehn.) Weese. *Calonectria xantholeuca* was recorded by Corner from Wicken Fen in *Trans. British myc. Soc.* XIX, 284, but the specimens have unfortunately been mislaid. As it is uncertain whether Kunze's fungus was a *Calonectria*, the name cannot be accepted without further evidence.

Calonectria Pseudopeziza (Desm.) Sacc.

This species was described by Desmazières in 1840 as *Sphaeria*, and was transferred to *Calonectria* by Saccardo in *Michelia*, I, 307. The description in Saccardo, *Syll. Fung.* is:—gregarious, small; perithecia globose, glabrous, smooth, subpapillate, apricot-coloured (*armeniaca*), then white (*eburnea*), collapsing and becoming concave; asci subhyaline; sporidia three to four, very large, elongated, straight or curved, four to seven septate. It was said to grow on decorticated wood, branches of *Laburnum*, and *Arundo Donax*, in France. Apparently it was a common species, but there are few later records. In Bommer and Rousseau, *Florule Mycologique des Environs de Bruxelles* (1884), 185, it was recorded on branches of *Robinia Pseudacacia*, Boitsfort, without comment, and in *Revision des Champignons dans les Pays-Bas*, Oudemans included a record by Mlle Destrée of its occurrence on the same host at The Hague, adding that he much regretted that he had not been able to study this species, which seemed to him too imperfectly known. The type specimen has apparently not been re-examined, and Weese, who has dealt with most of the earlier

species of *Calonectria*, does not appear to have published anything on this species. The description is scarcely sufficient for determination.

C. Pseudopeziza was recorded for Scotland on branches of laburnum in *Trans. Proc. Bot. Soc. Edinb.* xxx, 349, 1931. It occurred in 1924 on *Laburnum* affected with die-back in the Horticultural Gardens of the Edinburgh and East of Scotland College of Agriculture. It appears to be doubtful whether any perfect stage was observed, and no specimen appears to have been preserved. For these details I am indebted to Dr C. E. Foister. In view of the uncertainty regarding both the species and the record, the name should be deleted from the British list.

GIBBERELLA FLACCA (Wallr.) Sacc.

This species was recorded for England by Phillips and Plowright in *New and Rare Fungi*, No. 77, as '*Gibbera flacca* (Wallr.). On *Solanum Dulcamara*, bursting through the bark in clusters, which are composed of very minute perithecia.' In Plowright's note-book the locality is given as Hellgate Lane, Terrington, Norfolk, 24 April 1876, and he added to the record the comment, 'Too near *Gibb. pulicaris.*' The specimen is not now in Plowright's herbarium, nor in Herb. Kew. or Herb. B.M.

The fungus was described by Wallroth in *Flora Crypt. Germaniae*, II, 838, as '*Sphaeria flacca*; perithecia very crowded, small, ovate, black, shining, soft, obsoletely papillate, seated loosely on a thin, fleshy, pallid stroma, and simulating a pulvinate, subcircular, flaccid acervulus,...on *Solanum Dulcamara* and elder branches.'

Fuckel issued specimens on *Solanum Dulcamara* in *Fungi Rhenani*, No. 976. He stated in *Symbolae Mycologicae* that it was hardly different from *Gibberella pulicaris*, and did not give any spore measurements. In the copy of *Fungi Rhenani*, No. 976, in Herb. Brit. Mus. the perithecia are immature, but they appear to be *G. pulicaris*. Winter in *Rabh. Krypt. Flora*, cited *Fungi Rhenani*, No. 976, for this species, but he gave the ascospores as $23–28 \times 6\mu$, and his description appears to be that of *G. cyanogena*. A specimen in Herb. Plowright, Birmingham, marked '*Gibberella flacca* Wallr. Ad sarmentorum Solani Dulcamorae, prope Neuchatel (Helvetia), 9. 1876. Dr Morthier,' is *G. cyanogena*, with spores three-septate, $22–36 \times 6–7\mu$, the spore wall being collapsed between the septa.

Sydow, *Mycotheca Marchica*, No. 2358, *Gibberella flacca* on *Solanum Dulcamara*, Berlin, 9. 1888, has spores three-septate, $18–27 \times 6–7\mu$, rarely oval, one-septate, $36 \times 5\mu$, and the wall of the perithecium is rough with small cellular warts and projecting cells, in these respects resembling *G. cyanogena*, but the wall is violet-grey by transmitted light, and the fungus agrees with the description of *G. moricola*. In this specimen again, the wall of the spore is collapsed between the septa.

Wallroth's '*flacca*', however, refers to the group of perithecia, not to the spore.

Wollenweber gives the spores of *G. flacca* on *Solanum* as three-septate, 22·7 × 4·5 μ.

It would appear that the name, *Gibberella flacca*, has been applied to any *Gibberella* on *Solanum Dulcamara*, and in view of this confusion, and in the absence of any British specimen, the species was omitted from the list of British Hypocreales.

GIBBERELLA PULICARIS (Fr.) Sacc.

A specimen on elder, Bolton Percy, Yorks, 26 February 1938, coll. W. G. Bramley, has all the asci four-spored. The asci are 75–100 × 9–12 μ, and the ascospores 18–24 × 6–10 μ, dimensions which do not differ appreciably from those of the normal form.

GIBBERELLA BUXI (Fuck.) Wint.

This was recorded in *British Hypocreales* on one occurrence. There is a specimen in Grove's herbarium on a box leaf with *Pseudonectria Rousseliana*, without date or locality, but presumably British.

GIBBERELLA ZEAE (Schw.) Petch

Only one British specimen of this species could be cited in *British Hypocreales*, on grains of wheat, Cockle Park, Northumberland. In Grove's herbarium there is a specimen on the culm of an undetermined grass from Longdon, near Lichfield, 3 September 1909. The grass stem is slender and the fungus is inconspicuous. It is probable that careful search will show that *G. Zeae* is not uncommon on native grasses. I have since received specimens on *Phragmites*, collected by Mr E. A. Ellis at Wheatfen Broad, Norfolk, August 1939.

OPHIONECTRIA CEREA (B. & C.) Ell. & Everh.

This species occurs on effete Pyrenomycetes or on wood blackened by Pyrenomycetes. Mr E. W. Mason has kindly submitted to me specimens on beech, Ranmore Common, 10 June 1934, and 7 April 1937.

The perithecia are superficial, scattered or in small groups, minute, depressed globose, 0·12–0·18 mm. diameter, yellow-brown, irregularly rugose except round the ostiolum; the ostiolum is at first scarcely evident, then minute, conical and blackish; the perithecial wall is composed of small cells, yellow to brownish yellow by transmitted light; the asci are clavate, shortly stalked or almost sessile, the upper part of the wall strongly thickened, 70–90 × 8–10 μ, the spores in an overlapping bundle; the paraphyses are at first abundant, linear, branched, longer than the asci, finally diffluent; the ascospores are narrow fusoid tapering to each end, ends obtuse, straight or curved,

seven- to nine-septate, 40–50 × 3·5–4·5 μ. The perithecia are sometimes accompanied by hyphae (? conidiophores) of the *Cladosporium* type, which may occur round or on them.

This species appears to be widely distributed in Europe and North America, and has usually been recorded on *Diatrype Stigma*. It was originally described from North American specimens as *Sphaeria cerea* Berk. & Curt., and Seaver has given the synonyms, *O. Everhartii* Ell. & Galw. and *Calonectria fulvida* Ell. & Everh. Though I have not seen type specimens, it is apparently *O. episphaeria* Karst., *O. Briardi* Boud., and *Calonectria belonospora* Schroet. *O. Briardi* was said to have very minute hairs on the perithecium, but as these were described as 20–60 μ long and 5–6 μ diameter they were probably the hyphae referred to above. The English specimens agree completely with the original description of *Calonectria belonospora* in *Krypt.-Flora Schlesien*, III, (2) (1894), 261, where Schroeter remarked that the groups of perithecia were usually situated in a brown tomentum composed of brown hairs, 3–4 μ diameter, but that it was uncertain whether these belonged to the *Calonectria* or to its host. It is probable that the minute tufts of brown hyphae which sometimes occur on old *Diatrype Stigma* belong to this species.

PLEONECTRIA LAMYII (Desm.) Sacc.

This species was recorded, as *Nectria*, by Phillips and Plowright in *New and Rare Fungi*, No. 211 (*Grevillea*, x, 70), with the description, 'Perithecia caespitose, dark cinnabar red, rugose; ostiola minute, depressed; asci oblong, substipitate, octosporous, 0·074 × 0·014 mm.; sporidia oblong lanceolate, but obtuse at both ends, obscurely uniseptate, hyaline, 0·02 × 0·008 mm. Flitcham Abbey, King's Lynn, July 1881. On dead branches of *Berberis vulgaris*.' The description of the ascus and spores agrees with that of Fuckel in *Symbolae Mycologicae*, where the spores are described as uniseptate, i.e. as *Nectria*, not as *Pleonectria*. Dr J. Ehrlich informed me that he had examined the British specimen in Plowright's herbarium and found that it was *Nectria cinnabarina*. Consequently, there is no known occurrence of *Pleonectria Lamyii* in this country.

CORDYCEPS SPHECOCEPHALA (Klotzsch) Cooke

The conidial stage of this species, *Hymenostilbe sphecophila* (Ditm.) Petch, was found by Mr E. A. Ellis on an ichneumon among flood refuse at Horsey Mere, 5 May 1938.

(*Accepted for publication* 8 *March* 1941)

ON THE HISTORY AND DIAGNOSIS OF *POLYPORUS TOMENTOSUS* FRIES, *POLYPORUS CIRCINATUS* FRIES AND *POLYPORUS DUALIS* PECK

By W. R. HADDOW

(With Plate VI)

1. Introduction

Among the brown Polypori perhaps none are more difficult to name with confidence than *Polyporus tomentosus*, *P. circinatus*, and *P. dualis*. Often described as rare, these plants are common enough in the coniferous forests of northern Ontario. They are the cause of a characteristic and destructive butt-rot of their hosts, a parasitic disease which in certain types of spruce forest has a very considerable silvical significance.

A collection of one of the above is readily recognized as such, but which of the three names is applicable, is a question hard to answer. Correct diagnosis is perplexing, not so much on account of difficulty in identification, for the use of the microscope has facilitated this, but because of the existence of inharmonious descriptions of the species in authoritative works. This is particularly true in America, where the common acceptance of Peck's species, *P. dualis*, in spite of his own ultimate rejection of it as of specific rank, has added to the confusion existing with respect to *P. tomentosus* and *P. circinatus*.

While European mycologists for the most part have consistently preserved in their writings the essence of the original descriptions of *P. tomentosus* and *P. circinatus*, opinion is not unanimous that both species are valid. Moreover, with the amplification of the descriptions in later years to embody microscopic characters, certain discrepancies have appeared therein. Thus Patouillard (1900), figuring the hymenial elements of what he calls *Xanthochrous circinatus*, showed that species with rather bulbous, short, straight setae. Konrad & Maublanc (1926), on the other hand, have figured a plant under the name of *Fomes* (*Xanthochrous*) *circinatus* with setae strongly curved. As for *Polyporus dualis*, it has never been recognized in the European flora, and some European mycologists have relegated the name to synonymy under *P. circinatus* (Cooke, 1886; Saccardo, 1888).

Among American authors there is little agreement about the

number of species involved, their geographical range, or their specific characters. Thus Murrill (1904) united *P. tomentosus* Fries, *P. circinatus* Fries and *P. dualis* Peck under the name *Coltricia tomentosa* and described the plant as common to Europe and America. Lloyd, on the other hand, treating the forms under *Polystictus*, stated that *Polyporus tomentosus* was not found in America. He referred American plants to *P. circinatus* or *P. dualis*, both of which he considered good species. Neuman (1914), however, described *P. tomentosus* from Wisconsin, but gave *P. dualis* as a synonym. Overholts (1933), Shope (1931) and Lowe (1934), in recent publications, have all followed Lloyd in relegating *P. tomentosus* to Europe—a mistaken assumption—but these writers are not unanimous with respect to the status of *P. dualis*.

The above suggests a lack of proper discrimination among the forms involved. Under such circumstances, a careful examination of the original descriptions of the plants and a comparative study of authentic specimens is called for. The present paper comprises a brief historical review of the species concerned, and the results of original comparative studies in the field in Ontario, and of herbarium specimens from North America and Europe.

2. Historical

Polyporus tomentosus[1] was described by Fries in his *Systema Mycologicum* and again briefly in the *Epicrisis*. In subsequent notes (1849), he adds details with a view to distinguishing this plant from *Polyporus circinatus*.

The Friesian description of *P. circinatus* which is usually cited is that given in his *Monographia Hymenomycetum Sueciae* of 1863. Actually much earlier ones exist under the name *Trametes circinatus*. Thus the first,[2] in Fries's *Fungi Natalenses*, is inserted rather irrelevantly among the descriptions of certain Wahlberg collections from Natal. The actual

[1] *Polyporus tomentosus*, inaequalis, pileo suberoso azono stipiteque tomentosis fulvis, poris minutis aequalibus, albido-cinnamomeis. Valde irregularis; plerumque caespitoso-concrescens imbricatus, subexcentricus, stipite brevi, sed et solitarius, stipite longiori; nunc centrali, nunc laterali. Substantia primo spongioso-mollis, priorum crassior. Pori semper rotundi, obtusi, integri. In silvis ad terram, raro.

[2] *Trametes circinatus* inter *Trametem Schweinitzii* et *Tr. perennenem* medius, eisdem locis ac prior obvius, inter folia abiegna coacervata in silvis densissimus. Stipes subaequalis, unciam longus et fere crassus, durus, ferrugineo-tomentosus cum acubus pineis concrescens. Pileus spongioso-suberosus, ob superficiem dense et intertexto tomentosam tactu mollis, subvelutinus, prorsus azonus, explanatus, disciformis, 3–4 unc. latus, fulvo-ferrugineus, margine orbiculari integro. Contextus ferrugineus; inferne filamentosus, lignescens; superne floccosus spongiosus. Pori 3 lin. longi, minuti, integri, nec ut *Tr. perennis* lacerati, tantum ore inaequali, fusco-grisei, intus fusci; trama tenuissima sed manifeste e pilei substantia.

station of *Polyporus circinatus* was, of course, in the vicinity of Upsala. Again, in the *Summa Vegetabilium Scandinaviae* (1849), *Trametes circinatus* is listed along with *T. perennis* and *T. tomentosus*; and in a footnote it is described at some length as a newly discovered species.[1] Fries's figure of *Polyporus circinatus*, pl. 180, fig. 1 of the *Icones selectae Hymenomycetum* (1884), is a very poor representation, and does not agree with his descriptions in several respects.

The Friesian descriptions, though incisive, have proved to be inadequate for definitive purposes. They contain, of course, no reference to microscopic characters. The distinction between *Polyporus tomentosus* and *P. circinatus* is drawn from their gross appearance, and consists essentially in the nature of the context (which in the former is alleged to be homogeneous, and in the latter duplex), and in the relative depth of the pore layer—characters of dubious diagnostic value. Moreover, it is not possible to distinguish type specimens of the above. Fries never designated such—indeed he rarely kept the common Swedish fungi that he knew, though he often sent samples to Berkeley and others. In this instance, certain specimens have been preserved, although there is to-day no authentic material among Fries's collections at Upsala (sec Nannfeldt).

We turn now to *P. dualis*[2] described by Peck from New York in 1878. Here, too, the description refers only to gross characters, and one is struck by its similarity to that given for *P. circinatus* by Fries. It should be noted that Peck himself came ultimately to regard this plant as of varietal status, publishing the name *P. circinatus* Fr. var. *dualis* Pk. (1895). He had already described another variety *proliferus*, which is no longer commonly recognized. The type of *P. dualis* is preserved in the New York State Museum at Albany.

It should be clearly borne in mind that none of the original descriptions contained any reference to the microscopic characters of the plants. Since then, however, valuable diagnostic criteria have been discovered in the character of the setal elements in the hymenium,

[1] Novam hanc insignem speciem Upsaliae sub densis abietibus legi, omnino regularem, stratu duplici pilei, superiori spongioso molli *Tr. Schweinitzii*, inferiori suberoso duro *P. tomentosi* insignem. Pileus planus, stipesque tomentosi, ferriginei, sed pori valde elongati, tenues, fusci, ore cinereo regulari, praesente tamen trama angustissima pilei ut in seq., nec crassa praecedentium.

[2] *Polyporus* (Anodermei) *dualis* n.sp. Pileus dimidiate, sessile or sometimes produced behind into a stem-like base, convex or nearly plane above, somewhat uneven, rarely with a slight zonate appearance, single or caespitosely imbricating, two to four inches broad, nearly as long, tawny or tawny-ferruginous, the margin sometimes paler; flesh concolorous, the upper stratum of a soft spongy-tomentose texture, the lower firm and fibrous; pores minute, unequal, more or less angular, with thin dissepiments, whitish and denticulate on the edge, about equal in length to the thickness of the flesh of the pileus, dark ferruginous with a whitish or silvery reflection. Dead trunks of spruce trees. Adirondack Mts. Also at the base of pine trunks. West Albany. August and September.

and modern descriptions have been influenced accordingly. Unfortunately, most of the modern descriptions have been based on unauthentic specimens, and the criteria with respect to the setal character, now recognized as most valuable in diagnosis, have been employed indiscriminately. The current confusion is traceable directly to this cause, as can be clearly shown by following the history of the several species.

POLYPORUS TOMENTOSUS Fries

In Karsten's earlier work (1876) this plant was not recorded. In 1882 he described it under *Polystictus*, a disposition later adopted by Saccardo. He later (1889) transferred it to his new genus *Onnia*, members of which were distinguished from those belonging to *Polystictus* by the presence of setae in their hymenia. The essential specific diagnostic character of *Onnia tomentosa*, the type of the genus, was given as a homogeneous context, as distinct from the duplex one of *O. circinata.* No reference was made to the shape of the setae of either plant.

It is appropriate to refer here to pertinent work of Ellis and Everhart. In 1889 these authors founded the genus *Mucronoporus*, of which the type was *M. circinatus*. This was coincident with the establishment of *Onnia* by Karsten, and the two names are synonymous. The authors gave an account of a certain specimen received from the Canadian botanist Macoun from Prince Edward Island. It resembled *Polyporus tomentosus* Fr. but was thought at first to be a new species, on account of having setae in its hymenium, for no one had heretofore described these organs in *P. tomentosus.* But the authors go on to say that specimens of the latter, received ex herb. Karsten, were found to possess setae of the same type as those in Macoun's plant, which was then confidently referred to *Mucronoporus tomentosus*. It is figured in Pl. 8, and the setae are shown somewhat bulbous, but definitely straight (Ellis & Everhart, 1889).

Among modern American authors, Murrill is the only one who, in treating these species, has referred to authentic specimens. He stated that 'the types of *Polyporus tomentosus* at Upsala correspond in all respects with the plants found in America, having the same kind of spines and a dual context'. According to Prof. Nannfeldt there is actually no authentic material of either *P. tomentosus* or *P. circinatus* at Upsala, and it is a matter of uncertainty, therefore, what specimens Murrill actually examined. The plant named *Coltricia tomentosa* by Murrill is described by him as possessing setae more or less curved; but he cites the figure of Ellis and Everhart, already referred to, in which the setae are shown straight.

As already stated, Lloyd (1908) considered that *Polyporus tomentosus*

was a European species, not found in America. In describing the setae he implied that they were curved—'the same as in *P. circinatus*'. Neuman (1914) reported *P. tomentosus* from Wisconsin, but gave no description of the microscopic characters of the specimen. He gave *P. dualis* as a synonym, which leaves doubt as to the correctness of his diagnosis. Overholts (1933), following Lloyd, does not recognize *P. tomentosus* in the American flora, and Shope (1931) and Lowe (1934) are of the same opinion. In their recent publications, therefore, there is no treatment of this species.

In a little-known paper, Sartory and Maire (1922) suggested that *P. tomentosus* comprised a number of varieties of which *P. circinatus* is one. ('*Pol. tomentosus* Fr. doit probablement constituer un type auquel se rattache *P. circinatus* Fr. comme forme speciale.') They coined the cognomen '*Polyporus tomentosus* Fr. forme *circinatus* Fr.', and in variant form '*Pol. tom.* (var. ?) *P. circinatus* Fr.' They also published '*Polyporus circinatus* var. (?) ou forme: *Polyporus triqueter* Fr.' under which are united *P. triqueter* Fr. and *P. leporinus* Fr., which are considered forms of *P. tomentosus*. According to Lloyd, *P. leporinus* is the same as *P. dualis*, but it is doubtful whether *P. triqueter* belongs to this alliance. I have seen no authentic specimens, but Fries's figure, pl. 187 of the *Icones*, cannot be reconciled.

Curiously enough, Sartory and Maire did not discover the importance of the shape of the setae in the diagnosis of *P. tomentosus* and *P. circinatus*—a circumstance due perhaps to the inaccessibility of authentic specimens to them.

Polyporus circinatus Fries

Karsten (1889), in treating this plant under *Onnia*, noted the occurrence of setae in the hymenium, but did not describe their form. Ellis and Everhart (1889) described the setae of their *Mucronoporus circinatus* as curved. Patouillard (1900), on the other hand, figured what he called *Xanthochrous circinatus* with straight setae. Bourdot and Galzin's description (Bourdot and Galzin, 1927) conforms closely to the original but is amplified to describe the setae as either straight or curved. Konrad and Maublanc (1926) figure *Polyporus circinatus* under the name *Fomes* (*Xanthochrous*) *circinatus* with setae curved or hooked, and describe the organs as either straight or curved. They state that some consider it a variety of *Polyporus tomentosus* Fries, but that others hold it to be distinct.

Among American authors *P. circinatus* has received peculiarly perverse treatment. Lloyd at first (1908) described it as having straight setae, though later (1912) he said that they were curved 'as in *Polystictus tomentosus*'. He questioned whether '*P. circinatus* as found

in America' is really identical with the European plant of that name, and again whether *P. tomentosus* and *P. circinatus* are specifically distinct, suggesting that the alleged homogeneous context of the former might be characteristic of only young plants. Murrill referred it to his *Coltricia tomentosa* (1904).

Overholts, in his latest treatment (1933), states that all American forms should be referred here, and describes the typical form as having setae not curved. Shope (1931) holds the same view, and has figured a straight seta for *Polyporus circinatus* describing the organ simply as 'pointed'. According to Lowe, the setae are 'usually straight', but this author does not refer all his collections to *P. circinatus*; he considers *P. dualis* a good species.

POLYPORUS DUALIS Peck

This plant was described from New York in 1878. Cooke (1886) and Saccardo (1888) relegated the name to synonymy under *Polystictus circinatus*, and Peck himself came at last to regard it as a variety of that species. He continued to believe that it merited some distinction on account of its sessile or short lateral-stemmed habit and the comparatively high colour which dried specimens were said to display. It has never been recognized in the European flora, but many American mycologists regard it as a valid species. Ellis and Everhart (1889), describing a specimen received from Peck, noted that the setae were the same as in *Polyporus circinatus*, which they described as curved and regarded it as a form of the latter. Lloyd (1908), however, after examining the type, considered it distinct. He remarked that he had collected it himself in Temagami, Ontario, along with *Polystictus circinatus*. He noted that the setae were curved. Neuman (1914) believed, on the other hand, that *Polyporus dualis* was conspecific with *P. tomentosus*. Overholts assigned it finally to varietal rank under *P. circinatus*, on account of its curved setae—organs which according to him are straight in the typical form. According to Shope (1931) *P. dualis* is the same as *P. circinatus*, but Lowe (1934) considers it a good species, distinguished by its strongly curved setae.

A summary of the views of several American authors with respect to these plants is presented in Tables 1 and 2.

Table 1. *Disposition and range*

Author	*P. tomentosus* Fr.	*P. circinatus* Fr.	*P. dualis* Pk.
Ellis & Everhart (1889)	(Under *Mucronoporus*) Europe and America	Europe and America	= form of *M. circinatus* America
Murrill (1908)	(Under *Coltricia*) Europe and America	= *C. tomentosa*	= *C. tomentosa*
Lloyd (1908)	(Under *Polystictus*) Not found in America	Europe and America	America
Lloyd (1912)	= *P. circinatus*?	'*P. circinatus* of America' = *P. circinatus* of Europe?	
Neuman (1914)	Europe and America	Europe and America	= *P. tomentosus*
Shope (1931)	True *P. tomentosus* not in America. *Coltricia tomentosa* = *P. circinatus*	Europe and America	= *P. circinatus*
Overholts (1933)	Not found in America	Europe and America	= *P. circinatus* var. *dualis*
Lowe (1934)	True *P. tomentosus* not in New York. *Coltricia tomentosa* and '*P. tomentosus* of most Amer. authors, not Fr.' = *P. circinatus*	Europe and America	America

Table 2. *Diagnostic criteria*

Author	Context	Setae	Spores
	P. tomentosus Fr.		
Ellis & Everhart (1889)	—	Straight	—
Murrill (1904)	Duplex	More or less curved	5–7 × 2–4 μ
Neuman (1914)	Uniform by inference	—	—
	P. circinatus Fr.		
Ellis & Everhart (1889)	—	More or less curved	—
Lloyd (1908)	Duplex	Straight	5 × 3 μ Amer.
Lloyd (1912)	—	Curved	12 × 7 μ Eur.
Neuman (1914)	Duplex	—	—
Shope (1931)	Duplex	Pointed	4–6 × 3–4 μ
Overholts (1933)	Duplex	Straight	4–6 × 3–5 μ
Lowe (1934)	Duplex	Usually straight	4·5–5·5 × 3–4 μ
	P. dualis Pk.		
Ellis & Everhart (1889)	—	More or less curved	—
Lloyd (1908)	Duplex	Curved	—
Overholts (1933)	Duplex	Curved	—
Lowe (1934)	Duplex	Curved	6–7 × 4–5·5 μ

3. Authentic specimens[1]

It is extremely doubtful whether Fries preserved the plants from which he drew the descriptions of *Polyporus tomentosus* and *P. circinatus*. He was, of course, ignorant of the value of type specimens, and particularly of the value which was later to be put upon his own collections. Unfortunately there are no types or other authentic specimens of *P. tomentosus* or *P. circinatus* at Upsala. But there exist elsewhere specimens collected and named by Fries, which in the absence of designated types may be selected as typical. Such it has been my privilege to see.

In the Curtis herbarium, under the Farlow herbarium at Harvard University, there are the following specimens:

(1) *Polyporus tomentosus* Fries. The sheet consists of two specimens, one of which is labelled in Fries's hand '*Polyporus tomentosus* Upsala, Fries'. The other is in Curtis's hand '*Pol. tomentosus* Fr. Upsala Sweden. Fries misit Berkeley.' The specimens are of rather young plants, now somewhat worm eaten, but easily recognized. They both have straight setae.

(2) *Polyporus circinatus* Fries. This specimen is labelled in Fries's hand, and dated Upsala, 1849. The name has been over-written in pencil '*Trametes circinatus*'. It represents a rather old plant with a relatively deep pore layer and curved setae.

In the New York State Museum at Albany, the type of *Polyporus dualis* is preserved. It consists of abundant material of a large, old, almost sessile laterally attached form, having a well-developed pore layer and curved setae. After examining it I unhesitatingly refer it to *P. circinatus* Fries.

4. Discussion

From an examination of authentic specimens and a comparative study of many collections from Europe and America, I have concluded that two closely similar forms exist, common to Europe and America, namely, *Polyporus tomentosus* Fries and *P. circinatus* Fries. *P. dualis* Peck is identical with the latter. Both forms vary considerably in size, habit, stratification of the context, depth of pore layer, etc., according to age and habitat; and cultural experiments have shown that each form comprises several strains which differ conspicuously among themselves in cultural characters. With respect to the structure of

[1] Since the above section was written, I have received through the courtesy of the Imperial Mycological Institute, a report on certain specimens ex herb. Berkeley, in the herbarium of the Royal Botanic Gardens, Kew. While no authentic material exists there, it may be noted that, according to my correspondent, Mr E. W. Mason, the Swedish collections labelled *Polyporus tomentosus* have straight setae, while the only specimen under *P. circinatus* has curved setae.

the context, whether homogeneous or duplex, it has been found that all specimens exhibit a duplex structure. The relative thickness of the two layers, however, varies enormously, which has led to the description of certain specimens as with homogeneous context. The lower stratum is comparatively hard, sometimes turning vitreous when dried, and is composed of more or less straight radiating hyphae. The upper stratum is soft, and composed of hyphae which, though derived from those of the inferior layer, are crooked, branched and more or less erect, the whole forming a loose felty tomentum, often of considerable thickness. The typical difference between the forms is in the shape of the setal elements of the hymenium, which, in *P. tomentosus* are straight, and in *P. circinatus* strongly curved or hooked. There being no other reliable diagnostic criterion, *P. circinatus* may well be regarded as a variety of *P. tomentosus*.

By way of summary, I have ventured to redefine the species *P. tomentosus* and its variety *circinatus*:

Polyporus tomentosus Fries. Pileus stipitate, rarely truly sessile; stipe central, eccentric or lateral, often thick, short and irregular, tomentose; pilei often proliferating, and typically enmeshing conifer needles, dead twigs, etc.; soft coriaceous when fresh, drying rather hard, though light and brittle with a soft and friable upper surface; colour ochraceous, becoming rust-coloured with age; whitish below, especially towards the margin; azonate or faintly zonate; top plane or depressed, circular or flabelliform; margin acute or thicker in young plants, sterile below, often almost white; context golden yellow to brown, duplex in structure, the upper stratum tomentose, the lower radiately fibrous and silky, sometimes drying vitreous; lower stratum thick or very thin; tubes short, decurrent, the mouths circular to angular in older plants, often irregular in size, 2–4 per mm.; spores hyaline or pale yellowish, smooth, ovate, apiculate, variable in size $2{\cdot}2$–$3{\cdot}5 \times 4{\cdot}0$–$6{\cdot}8\,\mu$; setae abundant, 40–60×10–$12\,\mu$ straight in the typical form. Usually on the ground under conifers, sometimes on the host. Europe and North America.

Polyporus tomentosus var. *circinatus* Fries. As in the typical form, but with setae strongly curved or hooked.

5. Specimens studied

(*a*) *Polyporus tomentosus*

Forest Pathological Collections, Department Lands and Forests, Ontario. Specs. 189, 191, 192, on *Picea mariana*, near Oba, Ont.; spec. 622 on *Pinus Strobus* stump, Marten Lake, North Bay, Ont.; spec. 623 on ground at base of *Picea* stump, Marten Lake, North Bay, Ont.; spec. 624 on ground near stump of *Pinus Strobus*, Marten Lake, North Bay, Ont.

Herbarium, University of Toronto. Spec. 2006 on *Picea canadensis* roots, Bear Island, Temagami, Ont.; spec. 5757 on ground, Bear Island; spec. 7724 on ground, Cattle Island, Temagami, Ont.; spec. ex herb. Univ. of Michigan Isle Royal

Exped. 1930, F.P. 531, labelled *P. circinatus*; spec. ex Polyp. of N. Amer. distr. by N.Y. Bot. Gard., 1907, labelled *Coltricia tomentosa*; spec. ex herb. J. H. Faull No. 1277, Adirondack Mts.

Herbarium J. H. Faull (all labelled *Coltricia tomentosa*). Spec. 6037 on ground attached to conifer root; spec. 3171 on ground attached to buried conifer root, Temagami, Ont.; spec. 5207 on root of *Picea mariana*, Temagami, Ont.; spec. 3637 on ground in conifer forest, Priest River, Idaho, coll. J. R. Weir; spec. 6090 on ground attached to roots of *Picea*, Temagami, Ont.; spec. 4723 on ground attached to conifer roots, Temagami, Ont.; spec. 4731 attached to roots of *Picea mariana*, Temagami, Ont.; spec. 464 Muskoka, Ont.; spec. 1469 on ground among conifers, Reynoldsdale, Pa.; spec. 1254 under *Pinus*, Toronto, Ont.; spec. 3257 on buried conifer root, Temagami, Ont.; spec. 3528 on ground in conifer forest, Cleland Twp., Ont.; spec. 3255 on stump of fallen balsam, Temagami, Ont.; specs. 5165, 3220, 3248 on ground in conifer forest, Temagami, Ont.; spec. 1277 Seventh Lake, Adirondacks, N.Y.; spec. 3298 on ground under *Pinus Strobus*, Rondeau Park, Ont.; spec. 8866 at base of *Picea mariana*, Oba, Ont.

Farlow Herbarium, Harvard University (in the Curtis Herbarium). Spec. labelled in Fries's hand: '*Polyporus tomentosus* Upsala, Fries'; spec. on same sheet labelled in Curtis's hand: '*Pol. tomentosus* Fr. Upsala, Sweden. Fries misit Berkeley.'

(*b*) *Polyporus tomentosus* var. *circinatus*

Forest Pathological Collections, Department Lands and Forests, Ontario. Spec. 188 on *Picea mariana*, near Oba, Ont.; spec. 190 on *Picea mariana*, near Oba, Ont.; spec. 453 on *Pinus Strobus*, Lundy Twp., Ont.; spec. 634 on ground, under *Pinus resinosa*, Temagami, Ont.

Herbarium, University of Toronto. Spec. 2009 on *Picea mariana*, Temagami, Ont.; spec. 5912 on ground, Little Cross Lake, Temagami, Ont.; spec. 5913 on ground, Temagami, Ont.; spec. ex herb. Penna State Coll., Centre Co., Penna, under *Pinus rigida*, labelled *P. circinatus* Fr. var. *dualis* Pk.; spec. ex herb. L. O. Overholts No. 13773, State Coll. Penna on *Pinus rigida* roots; labelled *P. circinatus* var. *dualis*; spec. F.P. 51495 on *Picea rubra*, Great Gulf, N.H., coll. P. Spaulding labelled *P. circinatus dualis*.

Herbarium, J. H. Faull (the following are labelled *Coltricia tomentosa*): spec. 8607 on living red pine, Temagami, Ont.; spec. 8063 at base of *Picea mariana*, Temagami, Ont.; spec. 3188 on ground under *Pinus*, Temagami, Ont. (The following are labelled *Coltricia dualis* (Peck) (Faull)): spec. 5180 on stump of *Pinus Strobus*, Temagami, Ont.; spec. 1278 on trunks of *Pinus Strobus*, Cornell Univ., Ithaca, N.Y.; spec. 5226 on stump of *Pinus resinosa*, Temagami, Ont.; spec. 8602 at base of living *Pinus resinosa*, Temagami, Ont.; spec. 1255 on trunk of *Pinus Strobus*, Ithaca, N.Y.; spec. 399 on stump of *Pinus Strobus*, Port Credit, Ont.; spec. 3414 on dead *Pinus pungens*, Hendersonville, N.C. (G. F. Atkinson); spec. 1479 on dead conifer wood, Reynoldsdale, Pa.; spec. 3473 on dead conifer wood, East Angus, P.Q.

Farlow Herbarium, Harvard University (in the Curtis Herbarium). Spec. labelled in Fries' hand: '*Polyporus circinatus*, Upsala 1849.'

New York State Museum. Type spec. *Polyporus dualis* Peck.

Acknowledgements

The writer is indebted to Prof. J. H. Faull, Harvard University, for affording free use of his collections and for advice and criticism in the course of this work; to Prof. H. S. Jackson for placing the collections at the University of Toronto at his disposal; to the Curators of the Farlow Herbarium, and the Mycological Herbarium of the New York State Museum, for placing valuable specimens at his disposal; to Mr E. W. Mason, of the Imperial Mycological

Institute, Kew, for the examination of certain specimens in the Royal Botanic Gardens; to Prof. J. A. Nannfeldt and Dr G. D. Darker for helpful correspondence; and to Dr Irene Mounce and Mr A. J. Skolko for cultures.

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EXPLANATION OF PLATE VI

Fig. 1. Setae of *Polyporus tomentosus*. Specimen from the Curtis Herbarium under the Farlow Herbarium, Harvard University, labelled in Fries's hand: '*Polyporus tomentosus* Upsala, Fries'. (× 125.)

Fig. 2. Setae of *Polyporus tomentosus* var. *circinatus*. Specimen from the Curtis Herbarium labelled in Fries's hand: '*Polyporus circinatus* Upsala 1849'. (× 125.)

Fig. 3. Setae of *Polyporus tomentosus* var. *circinatus*. Specimen from New York State Museum, Albany, N.Y. type of *Polyporus dualis* Pk. (× 125.)

(*Accepted for publication* 5 *April* 1941)

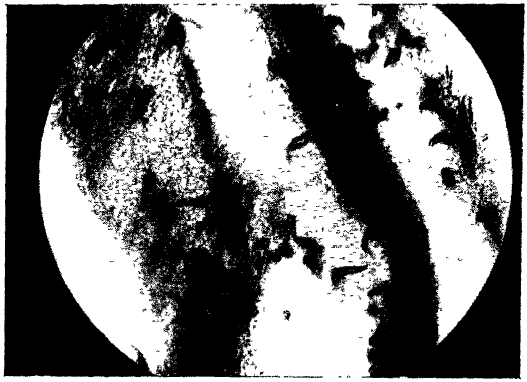

Fig. 3

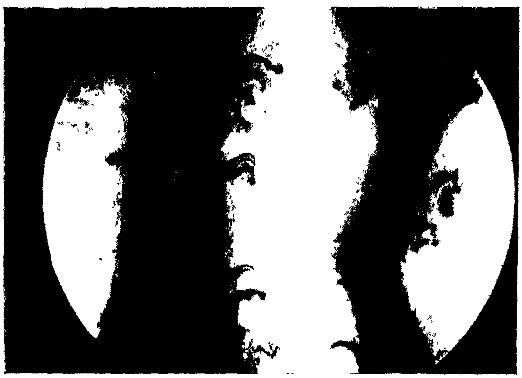

Fig. 2

Fig. 1

AN ADDITION TO THE FUNGUS FLORA OF BARRO COLORADO ISLAND

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Barro Colorado Island, about six square miles in area, is located in Gatun Lake in the Panama Canal Zone. Formerly a hilltop overlooking the Chagres River, the island was created in 1913–14 when this stream was dammed, and the rising waters flooded the surrounding lowlands to form Gatun Lake. Owing to the opportunities for research afforded by the establishment of a permanent biological station on Barro Colorado, the island has been visited by numerous investigators with the most varied of interests.

It has been stated by Standley (1933), referring to the phanerogamic flora, that 'Barro Colorado Island is perhaps the most thoroughly known area of equal size in all tropical America'. Comparatively little is known, however, concerning the fungus flora of the island, although some 130 species, mostly Ascomycetes and Basidiomycetes, are listed by Standley (1933) from collections made by himself and others, notably Weston. Weston (1933) has written a semi-popular account of the fungi of Barro Colorado, in which are included representative forms of most of the principal groups, based upon a six months' visit to the island. Stevens (1927, 1928) has studied especially the sooty moulds, and Martin (1938, 1939) has devoted considerable attention to collections of Heterobasidiomycetes from Barro Colorado.

Concerning the Phycomycetes, however, and especially the aquatic forms, very little information is at hand. Weston has made a detailed study of the water moulds of the island and the surrounding Gatun Lake from an ecological as well as a taxonomic point of view, but the results of this investigation have not as yet been published.

In the summer of 1940, Mr Nevin Scrimshaw made a two months' visit to the island for the purpose of studying tropical fishes in their natural surroundings, and made a number of collections at my request. It was desired to secure samples of soil to be examined for the presence of aquatic fungi. Some sixty samples from all parts of the island, complete with data concerning soil temperature, *p*H, and other ecological factors, were collected only later to be lost. The

present report is based on thirty-six soil collections, without accompanying data other than the date and locality of collection.[1]

From nine of these soil samples, aquatic fungi were isolated in water culture on boiled hemp seed. All of the isolates obtained proved to belong to the genus *Allomyces* (Butler, 1911). These nine *Allomyces* isolates were obtained from Lutz Creek, from the shore of the bay in which the laboratory is located, and from the shore of the bay immediately to the north of the latter. One isolate (designated Panama 23) was obtained from a brackish stream near the ruins of Old Panama, about five miles from Panama City. All of the successful collections were made by Mr Scrimshaw on 8 and 9 August 1940.

Measurements of the resistant sporangia of each of the nine *Allomyces* isolates were made according to a procedure previously described (Wolf, 1941 *a*, *b*). The results, as presented in the accompanying table, show a remarkable similarity in the size of the resistant sporangia of the eight isolates from the island, while those of the single isolate from Old Panama are only slightly smaller and perhaps not significantly so.

Masses of the resistant sporangia were removed from the water cultures, allowed to dry on pieces of filter paper, and after several weeks were germinated. The resulting mycelia, in each of the nine isolates, bore the paired orange and greyish gametangia characteristic of *Allomyces arbuscula* Butler (1911) emend. Hatch (1933, 1935). This was the only species to appear in the present collections.

A. arbuscula has not hitherto been reported from the island, although it is not uncommon in other tropical portions of the western hemisphere. It has been found in Mexico (Wolf, 1939), Cuba (Wolf, 1941 *a*), Costa Rica, Haiti, and the Dominican Republic (Wolf, 1941 *a*, *b*). There is no appreciable difference in the size of the resistant sporangia or the characters of the gametangia in the Barro Colorado isolates of *A. arbuscula* and collections of this species from the other localities mentioned. It is to be regretted that, owing to the small number of soil samples at my disposal, only a single species was encountered in the collections. It seems safe to predict, however, that a more thorough and extensive survey of the aquatic fungi of the island might well result in the finding of many new or otherwise interesting forms.

[1] The writer desires to express his most sincere thanks to Mr Scrimshaw for his generosity and cooperation in making these collections available for study.

Table 1. *Measurements of the resistant sporangia of the* Allomyces *isolates from Barro Colorado Island and vicinity*

Isolate	Species	Width (mode in μ)	Length (mode in μ)	75 % more between Width (μ)	Length (μ)
B.C.I. 7	*A. arbuscula*	35	43	32–37	40–49
B.C.I. 9	,, ,,	35	45	31–37	42–48
B.C.I. 12	,, ,,	35	47	33–40	43–52
B.C.I. 13	,, ,,	35	45	32–39	42–50
B.C.I. 15	,, ,,	37	49	34–41	44–52
B.C.I. 16	,, ,,	35	48	32–39	44–52
B.C.I. 21	,, ,,	33	45	30–37	40–49
B.C.I. 22	,, ,,	36	45	32–40	40–49
Panama 23	,, ,,	31	43	30–36	40–48

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(*Accepted for publication* 5 *April* 1941)

BULB ROT OF *SCILLA NUTANS* CAUSED BY *PENICILLIUM CYCLOPIUM* WESTLING

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I. Introduction

During the summer of 1938 a consignment of Dutch-grown bluebells (*Scilla nutans*) intended for physiological experiments was found to be useless for this purpose since a large proportion showed rotting of the bulb scales associated with the presence of a species of *Penicillium*. As an alternative supply, bulbs were obtained from woods in England. Some of these were also found to be rotted though not so severely as were the Dutch bulbs. Imported bulbs of *Scilla campanulata* showed a similar rot.

An investigation of the cause of this disease and of the possibility of controlling it was undertaken. During this investigation a similar disease of *S. campanulata* var. *albida* imported from Holland was described by Macfarlane (1939) who identified the causal fungus as *Penicillium cyclopium* Westling.

II. Occurrence and symptoms

No information is available of the condition of the bulbs when lifted in Holland, since, when these are received in this country for planting (i.e. in August or September), rotting if present is usually far advanced. It is not known whether this rotting is present when the bulbs are lifted or whether it develops as a result of conditions during transport. A stock of bulbs originally obtained from Holland was grown at the Imperial College Field Station, Slough, and lifted in August. A few of these bulbs showed small wet brown spots on the surface of the bulb scales. Other bulbs which appeared to be clean when lifted developed similar spots during storage. These lesions enlarged and became depressed. A white mycelial growth developed in the centre of the lesion and was followed by the formation of a mass of blue conidia of a *Penicillium* type. In the later stages the rot progressed inside the bulb leaving a hard shrunken yellowish brown crust at the surface over the rotted area. When such a bulb was cut open the interior showed a wet rot with abundant *Penicillium* spores. Some bulbs became entirely rotted and were then covered

with spores and often infested with mites. A few bulbs became shrunken and showed a dry type of rot but later masses of spores developed as in the more normal type.

A stock of infected bulbs was graded as follows:

(*a*) With small lesions, sometimes showing spores of *Penicillium*.

(*b*) With larger and deeper lesions, usually showing spores of *Penicillium*.

(*c*) With dry rot, associated with the presence of *Penicillium* spores.

(*d*) With severe wet rot, covered with masses of *Penicillium* spores.

A hundred bulbs of each grade (with the exception of grade (*d*) of which only thirty-six bulbs were available) were planted in November in a light well-drained soil. Their performance during the growing season and gain or loss of weight when lifted in the following summer were as shown in Table 1.

Table 1

Grade*	Bulbs planted	Plants produced	Plants which flowered	Flower spikes	Weight increase of bulbs %
(*a*)	100	95	58	80	+33·3
(*b*)	100	78	27	33	−43·3
(*c*)	100	77	18	25	−38·0
(*d*)	36	7	1	1	−93·3

* For explanation see text.

It is clear that the grades (*a*)–(*d*) represented a series of increasing severity of attack. Bulbs of grade (*a*) (i.e. with small lesions only) showed satisfactory growth and flowering and were more or less sound when lifted. At the other end of the series very few of the severely rotted bulbs (grade (*d*)) produced a plant and those which did grow were stunted, with yellowish foliage and few or no flower spikes. Some of these plants died down before flowering.

III. Isolations from diseased bulbs

Isolations were made from bulbs showing the symptoms described above, and also from others with indefinite small lesions, in order to discover the earliest stages of infection. Small pieces of diseased tissue were plated out in the usual manner and cultures were also made from single spores of *Penicillium* occurring on the bulbs. Isolations were made from a total of 194 bulbs. Of these, 120 (including all those with typical well-developed lesions) yielded a species of *Penicillium*. Miscellaneous fungi (chiefly species of *Fusarium* and *Trichoderma*) were isolated from bulbs with small indefinite lesions. It is clear that species of *Penicillium* predominated. All the isolates of this fungus were similar and it was concluded that they belonged to a single strain.

IV. Morphology and identification of the species of *Penicillium* isolated

Penicillium sp.[1]

(*a*) *General characters.*

On Czapek's agar medium, colonies deep, spreading, blue-green becoming brown with age, margin of colony wide, at first becoming yellowish green and finally blue-green; colourless drops later becoming yellowish brown scattered over surface of colony; medium at first pale yellow, later brown-purple; crystals found scattered abundantly in the medium; odour strong, mouldy.

Optimum temperature for growth is approximately 20° C.

(*b*) *Microscopic features.*

Vegetative hyphae, 2·5–7·4 μ (av. 4·6 μ) in diameter; in older cultures swellings at the apex and also in the middle of the hyphae, 10–25 μ in diameter; penicillus 45–75 μ in length; conidiophores verrucose, arising from aerial and submerged hyphae, single, or in clusters or fascicles, 3·7–4·6 μ (av. 4·3 μ) in diameter, two branches arising from the apex of the conidiophore, verrucose, 10–25 μ in length and 3·7–4·6 μ (av. 4·3 μ) in diameter.

Metullae verrucose 9·3–13·9 μ (av. 11·7 μ) in length and 3·7–4·6 μ (av. 4·3 μ) in diameter.

Sterigmata with well-defined apical tubes, 7·4–10·2 μ (av. 9 μ) in length and 2·5–2·8 μ (av. 2·7 μ) in diameter.

Conidia, globose, smooth, in straight or tangled chains, 2·8–3·9 μ (av. 3·4 μ) in diameter.

The strain of *Penicillium* isolated from *Scilla* bulbs was compared with a strain of *Penicillium corymbiferum* Westling from the stock collection of the Plant Pathology Department, Imperial College of Science and Technology, and with strains of *Penicillium* isolated from *Iris* and *Lilium* bulbs. In the *Lilium* strain and in *Penicillium corymbiferum* (which were identical) the majority of the conidiophores were in fascicles and coremia were frequently formed. The majority of the conidiophores in the *Scilla* and *Iris* strains, on the other hand, were single and no coremia were formed. It was therefore concluded that these isolates were strains of *Penicillium cyclopium* Westling, and this was supported by the size of the conidia which were rather larger than those of *P. corymbiferum*. The above description also agrees essentially with that given by Macfarlane (l.c.) for *P. cyclopium* isolated from *Scilla campanulata*.

[1] The terminology used is in accordance with Thom's Monograph (1930) *The Penicillia*.

V. Inoculation experiments

Bulbs of *Scilla nutans*, free from lesions, were washed in 95 % alcohol, soaked for ten minutes in a 0·1 % solution of mercuric chloride and finally washed in sterile water and dried. A piece of agar culture was then placed on the surface of the bulb or was inserted in a wound which was afterwards sealed with paraffin wax. Pieces of plain agar were similarly applied to controls. A few bulbs of *S. campanulata* were also used. Other bulbs were sterilized as described above and were then washed in sterile water and soaked for fifteen minutes in a suspension of spores of the *Penicillium*. Controls were soaked in water. The bulbs were placed on pieces of wet cotton-wool and stored for two weeks in sterile jam jars plugged with cotton-wool.

Table 2

Bulbs inoculated	Strain of *Penicillium* used	Mode of inoculation	No. inoculated	No. rotted
Scilla nutans	*Scilla*	Wounded	36	36
	Scilla	Not wounded	24	0
	Scilla	Soaked spore suspension	9	0
	Iris	Wounded	15	15
	Lilium	,,	5	5
S. campanulata	*Scilla*	,,	10	10
Iris (Wedgewood)	*Scilla*	,,	15	15
	Iris	,,	15	15
	Lilium	,,	5	5
Lilium regale	*Scilla*	,,	5	5
	Iris	,,	5	5
	Lilium	,,	5	5

The first three lines of Table 2 show that the fungus was unable to enter an unwounded bulb but that wounded bulbs were readily attacked. Wounded bulbs of *Scilla campanulata* were also attacked. This is in accordance with the results of Macfarlane (1939) who obtained no infection of unwounded bulbs even when these were kept under moist, warm conditions.

A comparison was made between *Penicillium cyclopium* isolated from bluebells and of *P. cyclopium* and *P. corymbiferum* isolated from rotted iris (bulbous *Iris* var. Wedgewood) and lily bulbs (*Lilium regale*) respectively.

Scilla, *Iris* and *Lilium* bulbs were wound-inoculated with the three strains of *Penicillium* and the results are shown in Table 2. All the controls remained sound.

Thus all three strains could attack all three hosts when introduced into wounds. No difference in degree of virulence could be detected. No positive results were obtained with unwounded bulbs.

VI. Control measures

Table 1 shows that slightly infected bulbs are able to grow, produce flowers and to increase in weight when planted in a light, well-drained soil. Thus in such a soil a stock should give satisfactory results if all bulbs showing severe rotting are discarded before planting.

Field observations suggest, however, that the disease becomes more severe in comparatively wet soils and that the attack by *Penicillium* may even be the factor limiting the establishment of bluebells in wet areas of woods or gardens. A stock of clean to slightly diseased bulbs of *Scilla nutans* was planted in the autumn in light, well-drained soil and in a heavier, poorly drained soil. Growth and flowering were good in both lots but when the bulbs were lifted in July, 448 bulbs out of 2200 (i.e. 20·4 %) grown in the heavy soil were severely diseased while there were only sixty-four severely diseased bulbs out of 2400 (i.e. 2·7 %) grown in the light soil.

A small scale experiment under more controlled conditions was also carried out in which clean or slightly diseased bulbs were planted

Table 3

Treatment	No. of bulbs used.	No. clean.	No. slightly diseased. *Penicillium*	No. severely rotted. *Penicillium*	No. completely rotted.
Dry	100	84	15	1	0
Wet	100	41	22	29	8

in autoclaved soil in small tins. Half of the bulbs were watered freely and half sparingly. The water content was kept fairly constant during the experiment by weighing the tins and adding water to bring them up to this weight at frequent intervals. The results of this experiment which are given in Table 3 show that the number of diseased bulbs and the severity of the disease were much greater in those grown in wet soil. Thus thirty-seven of these were so badly diseased as to be useless for planting while only one of those from the batches kept relatively dry was severely diseased.

A parallel series in which the bulbs were steeped for three hours in a 0·5 % solution of a proprietary organic mercurial fungicide gave similar results and no significant reduction in the amount of disease was obtained.

Replicated field experiments involving 4000 bulbs were carried out over two growing seasons in which bulbs were treated with a variety of fungicides (viz. formalin, mercuric chloride, cuprous oxide, certain proprietary organic mercurial fungicides, bleaching powder and certain non-mercuric organic fungicides of the nitrobenzene type) before planting. The majority of the bulbs were clean or had small lesions only, but experiments were also carried out with more severely

diseased bulbs. Some were planted in light soil and others in heavy soil. Under none of these conditions were there any beneficial effects of fungicidal treatment either on the amount of disease present or on the increase in weight of the bulbs during the growing season. Thus disease control can be best effected by discarding all severely diseased bulbs and planting the remainder in a well-drained situation.

It might, however, be possible to treat bulbs when lifted in such a way that they would remain sound when stored for sale or transport. An experiment was carried out in which bulbs were treated with a variety of fungicides when lifted in August. Both treated and untreated lots remained sound under conditions of good ventilation during August and September but the amount of disease was greatly increased under conditions of high temperature and humidity. Macfarlane (1939) was unable to obtain infection of wounded bulbs when these were kept dry while similar bulbs kept under moist conditions were all attacked. This attack was most rapid at relatively high temperatures. A small scale experiment also indicated that early planting of bulbs was advantageous. Thus when it is necessary to store bulbs for sale, a minimum period of storage under cool, well-ventilated conditions is likely to reduce losses.

VII. Summary

1. A strain of *Penicillium cyclopium* Westling was isolated from rotted bulbs of *Scilla nutans*. The symptoms are described in detail and a description of the fungus is given.

2. Inoculation experiments gave definite results, viz. that *Penicillium cyclopium* would penetrate only when bulbs were wounded. Strains of *Penicillium* isolated from *Lilium* and *Iris* bulbs could infect the wounded *Scilla* bulbs and, conversely, *Penicillium cyclopium* from *Scilla* was pathogenic to wounded *Lilium* and *Iris* bulbs.

3. In field experiments, various fungicides were used as dusts or in solutions to control the disease, but the results obtained were not conclusive. Both in the field and in greenhouse experiments the amount of disease was greater in wet soil.

4. Small scale experiments indicated that the amount of disease was greatly increased if bulbs were stored under conditions of high temperature and humidity.

Thanks are due to Dr L. E. Hawker for suggesting this investigation, for direction during its progress and for assistance in the preparation of the manuscript.

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(*Accepted for publication* 23 *May* 1941)

NEW METHODS FOR THE CULTIVATION OF WOOD-ROTTING FUNGI

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(With Plates VII and VIII)

Tests were started in 1937 with the object of finding a medium on which wood-destroying fungi would make more vigorous growth and on which they would fructify more readily than they do on malt agar. For these purposes experiments were carried out with a mixture which had been found in practice to stimulate the growth of mushroom spawn causing the mycelium to 'run' vigorously. This mixture, which is referred to below as the 'accelerator', was composed of the following ingredients:

Maize meal	50 parts by weight
Bone meal (containing 3·75 % organic nitrogen)	30 ,, ,,
Potato starch	17 ,, ,,
Sucrose	2 ,, ,,
Wood ash (from combustion of Scots pine sapwood)	1 ,, ,,

Preliminary tests using 1 and 5 % by weight of the mixture in 2 % malt agar showed that it has a marked stimulating effect on the growth of wood-rotting fungi in culture. Vigorous growth developed in cultures of several fungi which had previously made only very feeble growth on the malt agar alone. The medium containing 5 % accelerator supported more vigorous growth than that with 1 %. Experiments were then carried out adding the accelerator to sawdust instead of agar medium. Sawdust alone is not a satisfactory medium for the cultivation of most Basidiomycetes, and many wood-rotting fungi make surprisingly poor growth on it. It was felt, however, that if the mycelium could be induced to 'run' through the sawdust and develop vigorously, fructifications might be more readily produced on a sawdust medium than on agar, since the aeration of the medium is so much better, and the total amount of nutrient material greater. In sawdust a moisture content of 170 % (based on the oven-dry weight) has been found to be satisfactory for most fungi, although considerably higher moisture contents can be tolerated.

Dry sawdust—beech or spruce—was *thoroughly* mixed with 5% of the accelerator and brought to the required moisture content with tap water. Petri dishes were filled with the mixture and autoclaved for 20 min. at one atmosphere pressure. Control plates containing sawdust alone were also prepared. After sterilization the plates were inoculated with the twenty species of fungi listed below. When inoculating sawdust with small pieces from an agar culture it was found that the fungus developed better if the transplant were laid gently on the surface of the sawdust and not buried or covered with particles of it.

All the fungi produced exceptionally rapid and luxuriant growth on the sawdust containing the accelerator, the growth on the sawdust alone always being decidedly inferior to that on the treated sawdust. With certain species, e.g. *Lentinus cochleatus*, the growth on the control plates was negligible. Of the twenty species tested, eight formed fruit bodies on the sawdust with the mixture, while none fruited on a control plate. It is worthy of note that the strain of *Polystictus versicolor* used in these tests had never previously fructified on agar medium or wood blocks during the fourteen years it had been in culture in the Laboratory, during which time many hundreds of subcultures of it had been made.

Fungi used in Petri dish tests with treated sawdust

Beech sawdust		Norway spruce sawdust	
Fungus	Fructification, etc.	Fungus	Fructification, etc.
Armillaria mellea	(Rhizomorphs)	*Lentinus lepideus*	—
Collybia fusipes	—	*Lenzites trabea*	Formed
Collybia velutipes	—	*Merulius himantioides*	—
Fomes annosus	—	*M. lacrymans*	—
Lentinus cochleatus	Formed	*Poria Vaillantii*	Formed
L. tigrinus	—	*P. vaporaria*	Formed
Merulius serpens	—	*P. xantha*	Formed
Phellinus cryptarum	Formed	*Stereum sanguinolentum*	—
Polyporus umbellatus	—	*Trametes serialis*	Formed
Polystictus versicolor	Formed		
Fungus 344 from Palestine	Sclerotia formed for first time in culture		

N.B. Except in *Phellinus cryptarum*, all the fructifications which were formed bore normal basidiospores.

In order to discover the relative importance of the different ingredients in the accelerator a test was carried out to determine the loss in weight of samples of sawdust to which (1) maize meal, (2) bone meal, (3) wood ash, (4) starch, (5) the complete mixture, had been added. Samples of untreated sawdust were also included as controls.

The treated and control samples of sawdust were placed in weighed 100 c.c. conical flasks, oven-dried, reweighed and brought to 250%

moisture content with distilled water. The flasks after being plugged with cotton-wool were autoclaved for half an hour at one atmosphere, inoculated with *Merulius lacrymans* and incubated at 22° C. for four months. The sawdust was then oven-dried and the loss in weight determined and expressed as a percentage of the original dry weight.

RESULTS

Medium	Loss in dry weight % after 4 months
Sawdust only (controls)	1·9
Sawdust + 2·5 % maize meal	49·2
„ + 1·7 % bone meal	41·0
„ + 0·05 % ash	3·5
„ + 1·0 % potato starch	1·1
„ + 5·0 % complete accelerator	54·0

The differences in the losses in weight which were sustained are very striking, and it may be noted that similar differences in the mycelial development could be observed. It is evident that both the maize and the bone meal have a pronounced stimulating effect on the growths of the fungi, and it is hoped at a later date to investigate the relative importance of these ingredients and the physiological explanation of their effect on the growth of fungi. It was noticeable that the growth and loss in weight brought about by *Merulius* was much more uniform between one flask and another in the sawdust containing maize or bone meal, or the complete accelerator, than it was in the untreated sawdust. The use of the treated sawdust as a medium for cultivating the test fungi to be used in laboratory tests of the natural resistance to decay was, therefore, suggested.

When it is desired to carry out comparative tests on the resistance to decay of species of timber which are naturally highly resistant to attack, and which contain substances toxic to fungi, it is frequently difficult to get any growth from cultures on malt agar, as the toxic substances present in the wood may kill off the superficial mycelium. Trials were made, therefore, with cultures grown on the sawdust mixture after pilot tests with malt agar had proved unsatisfactory when testing western red cedar (*Thuya plicata*).

In a comprehensive test on the variations in resistance to decay in the different parts of a log of home-grown western red cedar, a wide range of fungi was grown on the sawdust medium in culture flasks. All the samples were supported above the fungus on glass rests. The species used are listed below, together with observations on the extent of decay in the cedar samples.

All the twenty-five species tested grew luxuriantly on the sawdust containing the accelerator, and the growth was always much more vigorous than that on plain sawdust (Plate VII, fig. 1). *Fomes roseus*,

F. Demidoffii, *Polyporus Berkeleyi* and *Trametes Pini* made no visible growth at all on the sawdust alone. Only four fungi—*Phellinus cryptarum*, *Polystictus versicolor*, *Poria subacida* and *P. Weirii*—grown on plain sawdust attacked the cedar samples, and in each, growth took place several weeks later than in the flasks with the accelerator. With certain fungi, e.g. *Fomes geotropus*, the growth from the sawdust with the accelerator on to the cedar was rapid (Plate VII, fig. 2).

This sawdust medium thus appears to be particularly suitable for the cultivation of fungi to be used for tests on the resistance to decay of naturally durable timbers, and it has also been found to be a very useful medium on which to cultivate the test fungi used in the laboratory testing of wood preservatives. The medium should also prove useful for the maintenance of standard culture collections of wood-rotting species, as fungi grown on it would not require such frequent subculturing as when grown on agar.

Condition of Thuya plicata *samples after* 9 *months in culture*

(Medium: sawdust plus accelerator)

Fungus	Remarks
Coniophora cerebella (Liese's strain)	Good growth. Many samples. Badly decayed. Av. loss in wt. 21·1 %
Echinodontium tinctorium	No growth
Fomes geotropus	Excellent growth. Slightly decayed
F. Demidoffii	No growth
F. pinicola (98 A)*	Slight growth at base. No attack
F. roseus (140 A)*	No growth
Lentinus lepideus (Liese's strain)	Very slight growth at base. No attack
Phellinus cryptarum	Excellent growth. Slightly decayed
Polyporus anceps	Moderate growth. Springwood decayed
P. balsameus	Excellent growth. Some attack
P. Berkeleyi	Very slight growth at base. No attack
P. borealis (Mounce's strain)	Very slight growth at base. No attack
P. guttulatus	Good growth. Slight to moderate decay
P. mollis	No growth
P. rugulosus (ex S. African mines)	Excellent growth. Moderately decayed
P. tephroleucus	Moderate growth. Badly decayed at base
Polystictus versicolor (F.P.R.L. strain)	Good growth. Many samples badly decayed
Poria incrassata	Excellent growth. Many samples badly decayed
P. subacida (Richard's strain)	Good growth. Slight decay in some samples. Av. loss in weight 3·5 %
P. vaporaria (Liese's strain)	Moderate growth. On average rotted at base
P. Weirii (Bur. Pl. Ind. Washington)	Excellent growth. Samples moderately decayed. White pockets. Av. loss in weight 12·9 %
Poria xantha	Excellent growth. Very slight attack
Trametes Pini (45 B)*	Slight growth. No attack
T. serialis (107 B)*	No growth, nor loss in weight
T. subrosea (106)*	Slight growth. No attack

N.B. Norway spruce sawdust was used in all the cultures except those of *Polystictus versicolor* for which beech dust was used.

The amount of accelerator added to the sawdust may vary within wide limits, and yet vigorous growth can still be obtained. As little as 1 %, if well mixed with the sawdust, has a pronounced effect on

* Reference numbers in F.P.R.L. collection.

most fungi—on the other hand, when exceptionally vigorous growth is required, up to 10 % may be used, but in general 5 % will be found to be about the optimum.

A preliminary test was carried out to ascertain the effect of adding the accelerator to soil. Samples of dark virgin loam were thoroughly mixed with 20 % by weight of the mixture, brought to a moisture content of 170 %, and after sterilization were infected with *Merulius lacrymans* and *Coniophora cerebella*. Both fungi grew rapidly on the soil plus accelerator, but made no appreciable growth on the control flasks containing soil only (Plate VIII, fig. 1). Samples of *Thuya plicata* (supported on glass rests), which were introduced into the flasks containing the soil plus mixture, were completely covered with mycelium in about ten days (Plate VIII, fig. 2).

Further comparative tests are necessary before it can be decided whether soil plus accelerator is better or indeed as good as sawdust with it. Soil has been used by a number of investigators as a medium for infecting test samples impregnated with wood preservatives, and it is suggested that the addition of a certain percentage of the accelerator described above would render the soil a much more suitable medium than soil alone, for the cultivation of the wood-rotting Basidiomycetes, which are used in laboratory tests on the toxicity of antiseptics.

It was found that it is possible to produce quick and luxuriant mycelial growth of certain wood-rotting fungi on absorbent cotton-wool by the following method: Pledgets of absorbent cotton-wool are soaked in distilled water until they contain about seven times their weight of liquid. These are then sprinkled lightly with the accelerator and piled in boiling tubes (4 cm. in diameter), leaving a space of 0·25 cm. between each pledget. The tubes are then autoclaved for half an hour at one atmosphere. An inoculum is placed on the top pledget in each tube.

The following fungi have been grown on cotton-wool plus accelerator: *Armillaria mellea*, *Coniophora cerebella*, *Fomes Laricis*, *Lentinus lepideus*, *Merulius lacrymans*, Palestine Fungus No. 344, *Phellinus cryptarum*, *Polyporus benzoinus*, *P. Schweinitzii*, and *Trametes serialis*.

All these fungi, with the exception of *Armillaria mellea*, made rapid growth on this medium. At 22° C. most of them had grown in three weeks to the bottom of the pile of wool—a depth of 16 cm. At the end of four months the wool was removed from these cultures and found to be decayed in all but those inoculated with *A. mellea*.

By this cotton-wool method inocula can be prepared quickly for infecting timber in an experimental floor, mine, toxicity chamber or living tree, its main advantage being that the inocula, unlike masses of sawdust or pieces of agar, can be nailed or tied in almost any position, and should remain moist long enough to enable the fungus

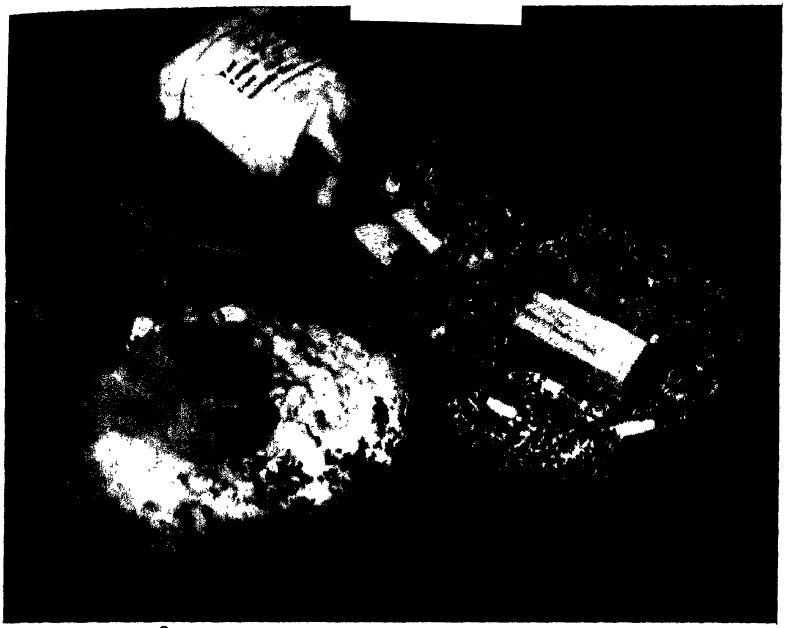

Fig. 2

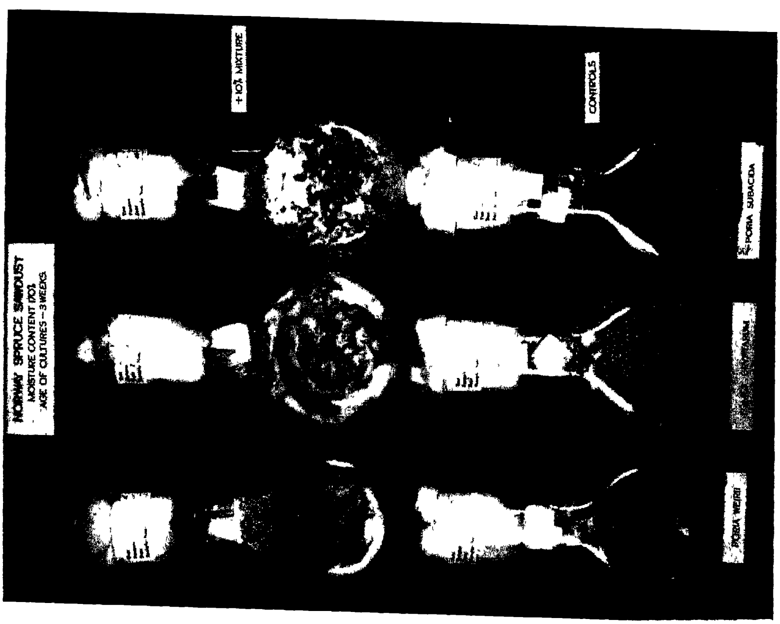
NORWAY SPRUCE SAWDUST
+10% MIXTURE
CONTROLS
PORIA SUBACIDA
PORIA WEIRII

Fig. 1

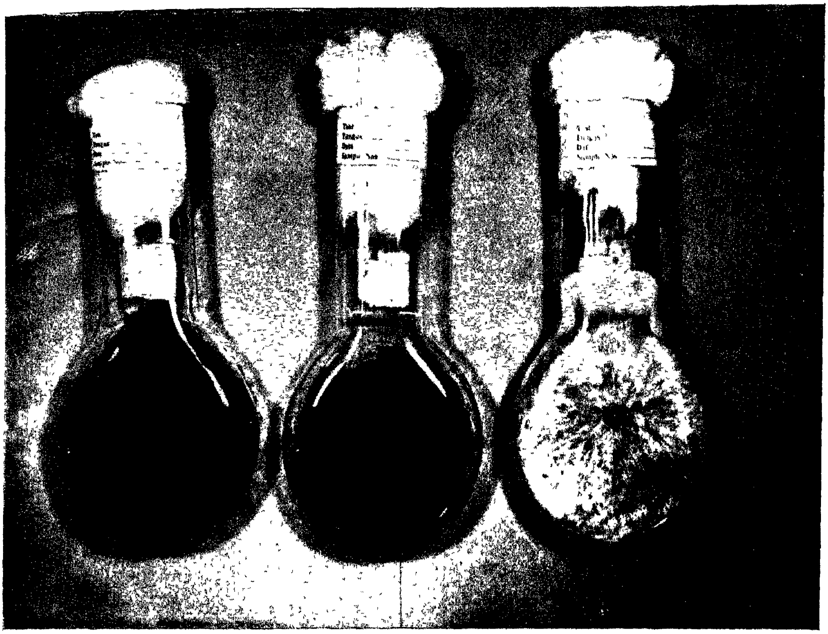

Fig. 1

to grow on to the test material. On account of their high water-absorbing capacity, the inocula can be watered if necessary. This would be particularly useful under conditions where inocula become dry before the fungus can develop on the test timber.

Summary

A new medium for the cultivation of wood-rotting fungi is described. This consists of sawdust of a readily decayed species of wood such as beech or spruce, well mixed with 5% by weight of an accelerator, the principal ingredients of which are maize meal and bone meal. On this medium exceptionally vigorous growth of a wide range of species has been obtained. The use of this medium for laboratory tests on the resistance to decay of naturally durable timbers or of samples impregnated with wood preservatives is suggested. The addition of the accelerator to garden soil or to cotton-wool also makes a medium on which very vigorous growth can develop.

The work described in this report was undertaken as part of the programme of the Forest Products Research Board, and is published by permission of the Department of Scientific and Industrial Research.

EXPLANATION OF PLATES VII AND VIII

Plate VII

Fig. 1. Cultures on sawdust media ready for inoculation of *Thuya plicata* samples.

Fig. 2. Home-grown *Thuya plicata* samples inoculated with *Fomes geotropus*. Medium: sawdust of Norway spruce (on left) + accelerator (on right) sawdust control. 8 days after introduction of samples.

Plate VIII

Fig. 1. Soil inoculated with *Merulius lacrymans*. Flask on right contains soil + accelerator, left and centre—soil only. Age of cultures 18 days.

Fig. 2. *Merulius lacrymans* on soil + accelerator. Two samples of *Thuya plicata* (home grown) 6 weeks after inoculation. The growth on to the wood takes place immediately, the samples being covered in 10 days.

(*Accepted for publication* 1 *June* 1941)

NEW AND INTERESTING PLANT DISEASES

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(With Plate IX)

10. A leaf blotch of *Cypripedium* caused by *Penicillium thomii* Maire

On passing through a commercial orchid nursery one cannot fail to notice the astonishing variety of spotting and blotching that occurs on the leaves of most plants old enough to flower. Articles on 'Spot' in orchids have appeared from time to time for many years in the horticultural press and elsewhere, but it is still true to say, as Berkeley (1865) did three-quarters of a century ago, that 'every gardener complains of the spot in Orchids, but no one seems to know how to prevent it, and few are agreed as to the cause'. The subject has been given little attention in this country since Brierley (1919) distinguished seven distinct forms of spot or blotch on various species of orchid. Three of these were attributed to non-parasitic causes and four to parasites.

Towards the end of May 1941 Mr E. Skillman, of the Ministry of Agriculture, brought me a few leaves of *Cypripedium callosum* which showed blotches of a type I had not previously seen. On visiting the nursery in Hertfordshire from which the specimens had been received, it was found that one or more of the older leaves on about half of several hundred plants showed similar blotching, and single blotches were also present on some of the younger leaves. A second batch of *C. callosum* obtained from another source was practically free from the trouble. The blotches were up to $1\frac{1}{2}$ in. across, rounded or elongated, relatively watery and uniformly deep brown, though frequently with a pale brown margin $\frac{1}{8}$ in. wide, surrounded by a water-soaked 'halo' about $\frac{1}{8}$ in. wide. Some were situated near the middle of the leaf and others were spreading inwards from the leaf edges (Pl. IX, fig. 1), while occasionally the whole of the stalk end of one or more of the oldest leaves was affected. Smaller, irregular, brown spots without the halo were also observed; these were harder in texture, and with the surface wrinkled as though the infection had been checked, and the spots were drying out. On most of the spots or blotches there was no visible fungal growth, but on a few there was a fine blackish incrustation consisting of the mycelium and

spores of a *Cladosporium* indistinguishable from *C. herbarum* (Link) Fr. Later, when a special search was made, conidiophores of *Penicillium* were also found, but only on one or two of the larger blotches.

Petri dish cultures made from the pale brown margin of several of the larger blotches and from the tissues in the water-soaked area, yielded *Cladosporium herbarum*, a sclerotia-forming *Penicillium*, and two kinds of bacterial colonies, one pink and one white. The *Penicillium* was isolated only from the water-soaked region, the others from both areas. All four organisms were obtained in pure culture and preliminary inoculation experiments were carried out with each one, through wounded leaves on a plant of *Cypripedium callosum* kept under a bell-jar at room temperatures. Negative results were obtained with the bacteria and with *Cladosporium herbarum*, but blotches up to $\frac{3}{8}$ in. across were produced within three days by the *Penicillium*. This was successfully re-isolated a week later, when the blotches were up to $\frac{3}{4}$ in. in diameter.

It may be recalled here that a species of *Cladosporium*, originally named *C. orchidearum* Cooke & Mass. (Cooke, 1888), was at one time regarded as the cause of a leaf and bulb disease of orchids (Smith, 1890), but Massee (1910), who erroneously cited the fungus as *C.* '*orchidis* (Cke. & Mass.)', was unable to infect the leaves of *Cattleya* and other orchids with it. On the other hand, Brierley (1919) attributed an olive-green blotching of different species of orchid to a species of *Cladosporium* that did not appear to differ from *C. herbarum* (Link) Fr.

On 14 June 1941 further inoculations were carried out with the *Penicillium* on plants of *Cypripedium callosum* kept reasonably isolated in one of the orchid houses on the nursery. Pieces from pure cultures of the fungus were placed on the wounded or unwounded upper surface of leaves of different ages. When examined nine days later none of the eighteen inoculations of unwounded tissues had taken, but every one of the eighteen inoculations made through small cuts in the leaf had given positive infection. Other leaves, that had been wounded but not inoculated, were still healthy. The spots or blotches produced on the wounded leaves were from $\frac{1}{2}$ to $1\frac{1}{2}$ in. across and closely resembled those occurring on naturally infected plants. On the whole the smaller spots occurred on the younger leaves and the largest ones on the older leaves. Some spots had apparently ceased to be active, while others (Pl. IX, fig. 2) showed the pale brown margin and water-soaked halo observed on naturally infected leaves. The *Penicillium* used for the inoculations was re-isolated without difficulty from eight of the spots.

A smaller number of inoculations was made on the leaves of *Cypripedium insigne Sanderae*, but this species proved much more resistant. No infection occurred through unwounded tissues and five

of the ten inoculations made through cuts gave a negative result. In the others slight infection occurred, but none of the spots produced was more than ¼ in. in diameter after nine days.

A pure culture of the *Penicillium* was sent to Mr George Smith at the London School of Hygiene and Tropical Medicine, and he very kindly examined it and identified it as a strain of *P. Thomii* Maire, which shows the spreading habit and the numerous pink sclerotia characteristic of the species, and differs only in minor details from Maire's description. I am very grateful to Mr Smith for the following diagnosis of this strain:

Cultures on Czapek agar predominantly sclerotial, with irregular conidial areas pale green, becoming pale grey-green; reverse dull yellow with patches of deeper yellow to dull orange. On wort agar young cultures predominantly conidial, greyish blue-green, turning darker and duller, velvety, with clusters of sclerotia developing gradually from centre outwards. Penicilli monoverticillate: conidiophores unbranched, smooth, 2·5–2·8 μ diam.; sterigmata abruptly pointed, 8–11 μ by about 2 μ; conidia subglobose, smooth, 2·5–3 μ in long axis; conidial chains in loose columns; sclerotia very pale dull pink, roughly globose, often confluent, up to about 200 μ in diameter.

The origin of the fungus is unknown, though it was probably imported with the plants some years ago. In the past *P. Thomii* Maire has been found on a variety of substrata. It was first named from a specimen on *Amanita ovoidea* in Algeria and has been observed growing saprophytically on mushroom and chestnut in the United States of America (Thom, 1930). A few years ago it was reported impairing the quality of stored butter in Germany, and in that country, as well as in Austria and England, it has been isolated from soil.

There appears to be no previous record of *P. Thomii* behaving as a parasite but it is considered to be the cause of the particular form of 'spot' or blotch described above, and as such it is the only species of the genus reported to be pathogenic to orchids. Infection takes place only through wounds, to which orchid leaves are particularly liable on account of their brittleness. Young leaves are less susceptible than older ones.

II. Leaf spot of *Primula*

In view of the proof recently advanced by Gregory (1939) that *Ramularia vallisumbrosae* produces amerospores, phragmospores and scolecospores, corresponding respectively to the genera *Ovularia*, *Ramularia* and *Cercosporella*, attention may be drawn to what will probably prove to be similar behaviour in *Ramularia Primulae* Thüm., the cause of Leaf Spot of Primulas. *R. Primulae* was regarded as new

to Britain when Massee (1891) found it on *Primula rosea* in Shropshire. Nowadays it is often found on wild primroses and sometimes also on cultivated forms. It is more conspicuous in wet than in dry seasons, but rarely causes serious damage.

Some years before Massee's record, Berkeley and Broome (1875) had described *Peronospora interstitialis* B. & Br. on primrose in Scotland. The fungus was not a phycomycete and was later transferred by Massee (1893) to *Ovularia* as *O. interstitialis* (B. & Br.) Mass., but Grove (1912) strongly suspected it to be merely a young condition of *O. primulana* Karst., which in turn he regarded as an immature stage of *Ramularia Primulae* Thüm. By suitable choice of specimens he was able to find all stages between the two extremes.

In May 1936 I examined some diseased seedlings of a *Primula Juliae* hybrid grown near Southampton. The leaves exhibited the yellow-brown or brown leaf spots commonly attributed to *Ramularia Primulae*, but the only fungus present on them proved to be a species of *Cercosporella*. It was identified as *C. Primulae* Allesch., previously reported in various parts of Europe on *Primula officinalis*, *elatior* and *acaulis* (*Rab. Krypt. Fl.* 1, 8, 1907, 425). Some of the seedlings of the *P. Juliae* hybrid were also attacked by *Peronospora Oerteliana* Kühn, and, acting on the advice given, the grower lifted all the plants from the affected beds, discarded those with pale or spotted foliage, and divided and replanted the remainder. Late in July, after an unusually wet summer, the same grower reported that *Cercosporella Primulae* had turned up again. He sent further specimens bearing spots indistinguishable macroscopically from those on the earlier material, but *Ramularia Primulae* was the only fungus present on them. Unfortunately, no cultures were made from the first material received and I have not again found the *Cercosporella*, but it seems highly probable that the two fungi are related genetically.

12. Leaf spot of *Helenium* (*Septoria Helenii* Ell. & Everh.)

At the beginning of July 1941 leaf spots appeared on two clumps of *Helenium* 'Moerheim Beauty' just coming into flower bud in my garden. Two other clumps only a few feet away were unaffected at the time but showed similar spotting within a fortnight. The spots, which caused no appreciable damage, were ½–2 cm. in diameter, amphigenous, scattered or spreading from the leaf edges, and sometimes coalescing. They were greenish brown, tan or chocolate-brown, paling later, rounded, sharply defined, often with a narrow, deeper coloured margin about ½ mm. broad, and occurred mainly on the lower leaves, with occasional spots on the stem leaves a foot or more above soil level. After a time the spots sometimes spread beyond the original margins. Ultimately some of the affected leaves

withered in part or altogether, though the outline of the original spots was usually still visible (Pl. IX, fig. 3).

Pycnidia of a species of *Septoria*, identified as *S. Helenii* Ell. & Everh., were scattered uniformly over the spots as minute blackish dots, barely visible to the naked eye. They were few or many, epiphyllous, at first immersed, then erumpent, individually pale brown with a thin parenchymatous wall, somewhat thickened and darker around an ill-defined ostiole, more or less spherical, 66–112 μ in diameter, the majority about 90 μ. The spores were straight or curved, slightly pointed at the ends, hyaline, 0–4-septate and measured $22–39 \times 2–3\,\mu$ (average length of 50 spores was 29·7 μ).

S. Helenii Ell. & Everh. appears to be the only species of the genus occurring on *Helenium*. It was collected on *H. autumnale* L. in Wisconsin by J. J. Davis in 1887 (Sacc. *Syll.* x, 369). In 1891 *Septoria nubilosa* Ell. & Everh. (Sacc. *Syll.* x, 369) was described from material on the same host, also collected by Davis in Wisconsin, but later Davis (1915) himself concluded that this was merely a form of *S. Helenii* in which the spots were not well developed. He found both forms on the same plant. *S. Helenii* has also been recorded from North America on *Helenium Hoopesii* Gray (Sacc. *Syll.* XIII, 551).

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EXPLANATION OF PLATE IX

Fig. 1. Leaf of *Cypripedium callosum* naturally infected by *Penicillium Thomii* Maire.

Fig. 2. Another leaf artificially infected by *P. Thomii*. Inoculated 14 June 1941. Photographed 23 June.

Fig. 3. Leaves of *Helenium* 'Moerheim Beauty' attacked by *Septoria Helenii* Ell. & Everh.

(*Accepted for publication* 20 *July* 1941)

Fig. 3

Fig. 2

Fig. 1

Photographs by W. F. Buck

INSTRUCTIONS FOR PREPARING 'COPY', SETTING TYPE AND READING PROOFS

CORRESPONDENCE between the editors of the *Transactions* and the Cambridge University Press has led to the preparation of a set of instructions for the guidance of the Press in producing the *Transactions*. These instructions are printed below, for the information of those intending to submit material for publication in the *Transactions*.

Contributors are asked to follow these instructions when they prepare their manuscripts; by so doing they will save the editors and printers much unnecessary mechanical work, and, by reducing the amount of correction to be done, they will help to reduce the cost of producing the *Transactions*.

(1) Spellings to follow *A New English Dictionary* (*Oxford Dictionary*).

(2) *Dates*. In text use: 21 March 1941. In tables: 21. iii. 41.

(3) Chemical symbols, printed in roman type, may be used in tabular matter for convenience of space. In the text, symbols must not be used, the name of the element or compound being put out in full: e.g. nitrogen, *not* N; ferrous sulphate, *not* $FeSO_4$.

(4) Use figures for all dimensions, weights, distances, etc., e.g. 4 kg., 5 in., 2·5 m., 3 cm., except where the style clearly demands the use of words, e.g. 'two miles from Cambridge'. In reading matter spell out numbers of less than three figures: e.g. ninety-nine, twelve; but 101, 238. If numbers are in groups, use figures, e.g. 12, 208, 32, 41.

Avoid figures as numbers at beginning of sentence. Use 'half a mile' *not* '½ mile', and 'one-fifth' *not* '⅕' or '1/5', when fractions stand alone.

Give time of day as 4 a.m., 6 p.m., but use 'four o'clock' *not* '4 o'clock'.

(5) Contract collective numbers: e.g. 1921–4, 1938–41, 1903–4, 1911–12; *but* from 1914 to 1920, *not* from 1914–20.

(6) *Botanical terms, etc.* Names of genera and species should be italicized. The specific epithet may begin with a capital or with a lower-case letter; always follow copy.

Anglicized words derived from Latin names of groups should begin with a lower-case letter: e.g. Gymnospermae, gymnosperms; Coniferae, conifers.

When the name of an author follows the botanical name no punctuation should be inserted between that name and the authority, but a comma should be inserted between the authority and the date which follows it, if there is a date. Names of authors are sometimes

placed in parentheses, and copy should always be followed, e.g. *Pluteus* Fr.; *Pluteus gracilis* (Bres.) Lange, 1924.

When there are collaborating authorities, their names, or the usual abbreviations for those names, will be linked by ampersand (&), and *not* by and, et, or any other form, e.g. *Corticium Solani* Bourd. & Galz.

(7) Use n.gen., n.sp. *not* nov.gen., nov.sp. or the many variants. Use the form gen.nov., sp.nov. with Latin diagnoses.

(8) Reduce hyphenated words to a minimum, but the general rules set out in *Rules for Compositors & Readers at the University Press, Oxford*, 1936, pp. 33–7 are to be followed.

(9) The decimal point must always be preceded by a figure, e.g. 1·234, 0·123.

(10) Reference to plate numbers is made by roman numerals, e.g. Pl. III; to Figs. and Tables by arabic numbers, e.g. Fig. 2 or Text-fig. 2, and Table 2.

(11) *References.* References in text and in alphabetical list at end of article are governed by the following rules:

(i) *In text.* References are denoted by giving name of author followed by date of publication from which citation is made, e.g. (Brown, 1941). Collaborating authors are joined by an ampersand when reference is parenthetical, but 'and' must be used in running text: e.g. 'Smith and Brown (1941) have shown...'; 'Some authors (e.g. Smith & Brown, 1941) have shown...'. Where three or more authors have collaborated full names should be given at first citation and after that *et al.* should be used with first name only: e.g. (Smith, Jones & Robinson, 1941) at first, then (Smith *et al.* 1941) afterwards.

(ii) *Alphabetical list at end of article.*

(*a*) Author's name, followed by initials. Collaborating authors should be joined by &.

(*b*) Date of publication in parentheses. Where an author has published two or more papers or books in any one year, *a*, *b*, *c*, etc., should be added to date and inside parentheses, both here and in text.

(*c*) Title of paper or article in full and in roman type without quotation marks. If translated from a foreign language crotchets should be inserted at beginning and end of title.

(*d*) Name of periodical or journal from which article is cited, and printed in italics. Titles of journals to be abbreviated in accordance with editor's marking; the *World List* will not always be followed. All titles of periodicals must be repeated, the use of ibid. not being allowed.

(*e*) The name of a book which is cited, printed in italic, followed by edition number.

(*f*) Volume number in roman numerals and in roman type, followed by complete page numbers of article. Where no volume number is given print p., no. or part, in ordinary type.

The following shows complete references:

Brown, A. B. (1941). The nature of fungi. *Proc. Roy. Soc.* B, cxx, 19–25.

Brown, A. B. & Jones, D. C. (1939). Isolation in microbiology. *Trans. Brit. myc. Soc.* xxviii, 102–50.

Smith, C. B. (1928). *English Fungi*, 3rd ed.

Pavlov, X. Y. (1940). [Wood-destroying fungi.] *J. russe Bot.* vi, 38–43. Cited in *Rev. appl. Myc.* xxi, 16. (Note translation from another language.)

Peters, T. J. (1936). Polyporaceae. *Ann. Mag. Nat. Hist.* (9), viii, 113–25. (Note series number in parentheses.)

Dodge, A., Fynn, Q. & Fleet, M. (1940). Effects of alcohol. *Publ. Carneg. Instn*, no. 223, pp. 1–181. (Note number of publication and page numbers, as this is a complete publication.)

Adam, C. & Eve, J. (1932). Botanical problems. *Bull. Dep. Agric. S.A.* no. 48, pp. 36–58.

(12) Words of foreign origin generally accepted as part of the English language, and well-known scientific terms, should be printed in roman type. Examples are: in situ, in vitro, bona fide, prima facie, résumé, role.

(13) *Capitalization.* Avoid capital initials as far as possible, but no hard and fast rules can be laid down about them. Names of diseases of plants, etc., must be left to the discretion of the editor.

(14) Single quotes ' ' should be used throughout, and only in a quotation within a quotation should double " " be used.

(15) The following is a list of contractions in general use. This list must be strictly adhered to, unless special instructions are given to the contrary; contractions will not be used in running text, except as provided for in Rule 4:

Absolute	abs.	Calculated	calc.
Acceleration	acc.	Calorie (small, gram-calorie)	cal.
Alternating current	a.c.	Candle-power	c.p.
Ångström units	Å.	Centigrade	C.
Ante meridiem	a.m.	Centimetre	cm.
Approximate	*c.*, approx.	Centimetres per second	cm./sec.
Atmosphere	atm.	Coefficient	coeff.
Atomic weight	at. wt.	Concentration	conc.
Boiling-point	b.p.	Constant	const.

Cubic inch	cu. in.
Cubic foot	cu. ft.
Cubic yard	cu. yd.
Cubic millimetre	cu. mm.
Cubic centimetre	c.c.
Cubic metre	cu. m.
Cubic (except c.c.)	cu.
Decalitre	dl.
Decimetre	dm.
Dextrorotatory	*d*-
Direct current	d.c.
Drachm or dram	dr.
Fahrenheit	F.
Feet per second	ft./sec.
Feet per minute	ft./min.
Foot	ft.
Foot-candle	f.c.
Freezing-point	f.p.
Gallon	gal.
Grain	gr.
Gram	g.
Gram-molecule	g.mol.
Greenwich mean time	G.m.t.
Height	ht.
Horse-power	h.p.
Hour	hr.
Hundredweight	cwt.
Hydrogen-ion concentration (negative log of)	*p*H
Inch	in.
Iodine value	i.v.
Kilo-	k
Kilogram	kg.
Kilogram-calorie	kg. cal.
Kilolitre	kl.
Kilometre	km.
Kilowatt	kW.
Laevorotatory	*l*-
Latitude	lat.
Litre	l.
Longitude	long.
Low frequency	l.f.
Maximum	max.
Mega- or Meg-	M
Melting-point	m.p.
Metre	m.
Metre-candle	m.c.
Micromicron	$\mu\mu$
Micron	μ
Milli-	m
Milligram	mg.
Millilitre	ml.
Millimetre	mm.
Millisecond	msec.
Minimum	min.
Minute	min.
Molar	*M*
Molecular weight	mol. wt.
Mouse unit	m.u.
Normal	*N*
Ordnance datum	O.D.
Ordnance survey	O.S.
Ortho-	*o*-
Ounce	oz.
Page, pages	p., pp.
Para-	*p*-
Parts per million	p.p.m.
Pennyweight	dwt.
Per annum	p.a.
Per cent	%
Pint, part	pt.
Post meridiem	p.m.
Potential difference	p.d.
Pound	lb.
Quart	qt.
Rat unit	r.u.
Relative humidity	R.H.
Revolutions per minute	rev./min.
Second	sec.
Secondary	*sec.*-
Specific gravity	sp. gr.
Specific heat	sp. ht.
Square inch	sq. in.
Square foot	sq. ft.
Square yard	sq. yd.
Temperature	temp.
Tertiary	*tert.*-
Thermal death point	t.d.p.
Vapour density	v.d.
Vapour pressure	v.p.
Volt	V.
Watt	W.
Weight	wt.
Yard	yd.

PROCEEDINGS

PHYTOPATHOLOGICAL MEETING

Held on 17 April 1941, in the Lecture Theatre of the Botany School, Cambridge

The President, W. C. MOORE, Esq., M.A., in the Chair

Prof. F. T. BROOKS. Phytopathological observations in Australia and New Zealand, 1939.

(The author did not supply a summary.)

Dr R. E. TAYLOR. A Wilt disease of *Godetia* and other ornamental plants.

Fungi isolated from wilting plants of *Godetia* and Sweet Sultan in Cambridge were received from Prof. F. T. Brooks in 1938. These, together with other isolates obtained from *Godetia*, *Antirrhinum* and *Clarkia* were shown to be pathogenic to their respective hosts and to cause similar symptoms.

The typical symptoms as they appear in *Antirrhinum*, *Clarkia*, *Godetia* and Sweet Sultan are browning of the stem, principally in the lower parts of the plant, the extension of the lesion and final encirclement of the stem, followed by wilting. Pycnidia subsequently develop on the dead shoots.

One of the more interesting aspects of the investigation is the wide host range of each of the various isolates, and except for slight discrepancies the host ranges are comparable.

A careful cultural comparison of the isolates was made and although latterly this work was rendered difficult by the propensity of the fungi for altering in type, initially, however, the characters were almost uniform. Passage through different hosts did not appear to influence the cultural characters.

The mode of infection was investigated and consistently successful inoculations were obtained only when inoculation was accompanied by wounding. Infection was initiated through stems and leaves, and plants were conveniently infected in routine inoculation work by placing spore-suspensions on cut axillary shoots.

The fungi investigated belong to the Sphaeropsidales. The spores are hyaline, cylindrical with rounded ends, $6–9\ \mu \times 2{\cdot}5–3{\cdot}5\ \mu$ with 5–40% uni-septate; occasional spores are bi-septate. The characters are consistent with those of *Diplodina*. After careful comparison with material in the Kew Herbarium, the fungus from *Antirrhinum* is considered to be *Diplodina Passerinii* Allesch. Great similarity was observed in the appearance of the disease produced by the various isolates on different hosts, and in culture they do not differ sufficiently for them to be regarded as different species. The comparison strongly suggests that the fungi are separate strains of a single species, provisionally determined as *Diplodina Passerinii* Allesch.

Dr W. J. DOWSON. Soft-rots due to green fluorescent bacteria.

Up to the present the majority of bacterial soft rots have been ascribed to what I here designate as *Bacterium carotovorum*, a member of a genus of non-sporing bacteria characterized by possessing paratrichous flagella and strong fermenting powers. A second species, *B. Aroideae*, attacks arum lily corms and hyacinth bulbs

in Britain but it has a much wider range of hosts in the United States and the tropics. *B. phytophthorum* causes the soft rot of potatoes known as Black Leg.

Quite recently a member of a different genus of bacteria was shown by Bonde in the United States to cause a soft rot of potato tubers in the ground, characterized by a yellowish colour as distinct from the white rot due to *B. carotovorum* or *B. phytophthorum*. Bonde did not identify this organism but stated that it was one of the 'green fluorescent' bacteria which are quite distinct from *Bacterium*. They possess a tuft of flagella situated at one end (polar or cephalotrichous), secrete the yellowish green pigment, fluorescin, into certain media, and exhibit but feeble fermenting powers. These 'green fluorescent' bacteria, which cause by far the greatest number of bacterial diseases of plants, constitute the genus *Pseudomonas* and one of them *P. marginalis* is responsible for a widespread disease of lettuce known as Marginal Spot prevalent here and in the United States. Under very humid conditions this Marginal Spot rapidly develops into a typical soft rot in which all the tissues, including the vascular system, are involved. So far *P. marginalis* is only known naturally to attack lettuce but its range of artificially inoculated hosts is considerable and is similar to that of the three species of *Bacterium* already mentioned. Onions, turnips, green tomatoes, cucumbers, green potato stems and potato tubers are quickly rotted and Bonde's 'green fluorescent' bacterium may well be this organism, as it produces a yellowish rot.

I recently investigated a rot of swedes characterized by extensive brown areas of softened tissue containing bacteria only. This rot was not nearly so soft or wet as is produced by *Bacterium carotovorum* etc. which could not be isolated from brown areas. A green fluorescent bacterium was isolated which under partially anaerobic conditions produced exactly the same kind of rot when introduced into turnips. It was at first suspected that this swede organism might be *P. marginalis*, but its biochemical reactions proved to be slightly different and it failed to produce a severe rot of lettuce.

A comparative set of tests of the pathogenesis of certain available pure cultures of species of *Pseudomonas* resulted in the identification of the swede organism with *P. Medicaginis* var. *phaseolicola*, the cause of Halo Blight of dwarf beans. Subsequent enquiry showed that to windward of the diseased swedes a crop of dwarf beans affected with Halo Blight had been grown the previous season and it would seem possible that some of the bean trash had been conveyed (by the wind) to the swedes. There seems no doubt that at least one soft rot disease is due to a species of *Pseudomonas*, and others are suspected, particularly certain types of potato tuber rots. This possibility should be borne in mind in considering control measures, for, whereas *Bacterium carotovorum* and other species of the genus *Bacterium* can gain entrance only through wounds, both *Pseudomonas marginalis* and *P. Medicaginis* var. *phaseolicola* are true parasites which enter their respective hosts through the stomata. The actual method of the swede infection is not at present known but is under investigation.

Dr S. Dickinson. Experiments on the physiology of obligate parasitism. II.

(The author did not supply a summary.)

Dr W. A. R. Dillon Weston. Field observations on some cereal diseases and their control.

The modern proprietary organo-mercury seed disinfectants if correctly used control Bunt of wheat, Covered Smut and Leaf Stripe of barley, and Leaf Spot and the Smuts of oats. Sometimes, however, the control of the oat smuts, although good, is not as effective as a formalin treatment.

An interesting feature was recorded in one experiment with the oat smuts, for in a series of weekly sowings with untreated seed it was noted that in the later

sown plots there was a higher percentage of smut than in those sown at earlier dates.

In some circumstances the compounds contained in these organo-mercury seed dressings may cause a characteristic phytocidal effect when they are applied to, and held by the grain in overdoses. The seed may be killed outright or it may begin to germinate and the coleoptile to appear, but further development is abnormal, distinguished by thickening of the tissues of the coleoptile and stunting of the roots. These symptoms are very distinctive, and typical cases are not likely to be confused with injury to seed caused by the incorrect use of copper sulphate, formalin or the hot water treatment. Although instances of injury to seed corn by the organo-mercury seed disinfectants are relatively rare, the main factors responsible for them are known. Weston and Brett[1] found that, provided the grain shows relatively high initial germination, is of sound physical condition and is superficially dry when dusted with these materials, no immediate injury to the grain is likely. Further, if such seed is stored, then, provided it is kept under dry, cool conditions, with adequate ventilation, it is unlikely that any marked decrease in germination will occur during several months. In continuing this investigation it was found that such seed, correctly treated and stored, can be kept for periods up to a year. If, however, it is necessary for a farmer to keep such grain for any lengthy period, he would be well advised to send samples periodically to the Official Seed Testing Station, so that an accurate check could be kept of the germinating capacity. Although the modern seed disinfectants are most effective, research on them continues and one interesting trend is the incorporation with them of plant hormones, as it has been suggested that these 'growth hormones' stimulate root growth and give the plants an earlier start and a better chance. In this country, however, there is little evidence that yields have been materially increased by the use of seed dressings of this type, and research in Canada and the United States indicates that although such plant hormones are potentially capable of inducing physiological activity when applied in dust dressings, they do so in practice only under conditions which occur very rarely.

Field observations over a number of years on the well established English wheat varieties have not shown any very noticeable difference in the intensity of Loose Smut, *Ustilago Tritici*, from year to year; but certain varieties, recently introduced have been more markedly affected. In experimental work with the hot water treatment we find that if the grain has to be stored for any length of time after treatment, and it is not thoroughly dry, then its germinating capacity may be seriously impaired: it is for this reason that after treating our own seed stocks we bring the grain back to its original moisture content by drying over a wind channel. The control measure usually suggested to the farmer is to obtain his seed wheat from a crop known to have been free from this disease, alternatively that he should change to a variety which is less susceptible.

Wheat varieties infected with *Tilletia caries* are usually more susceptible to *Puccinia glumarum*, but loose smutted tillers when examined at harvest time have not shown a similar correlation.

In this country it is usually considered that Leaf Blotch of barley, *Rhynchosporium Secalis*, is of small importance. It is doubtful if this is so for there is no definite evidence of the effect of the disease on yield or quality of grain. In experimental work no indication has been obtained that the disease is seed-borne, and it seems likely that the disease carries over from year to year on rogue barley plants, and on grasses such as *Bromus sterilis*, *B. mollis*, *Dactylis glomerata* and *Hordeum murinum*.

At or just prior to harvest, many enquiries are usually received concerning the cause of thin stands, empty bleached ears, and prematurely ripened grain which are the features of such wheat and barley failures. These partial failures are usually due to the Take-All fungus, *Ophiobolus graminis* and sometimes, in addition, wheat stem sawfly, *Cephus pygmaeus*, or Hessian fly, *Mayetiola destructor*; occasionally species of *Fusarium* are responsible.

[1] Weston, W. A. R. Dillon & Brett, C. C. Seed Disinfection, *Nature*, CXLV, 824.

The major predisposing factor leading to the condition is the taking of corn crops too frequently in the rotation. If a crop of wheat or barley has shown Whiteheads, it should not be followed by either of these crops, and this applies particularly to the farms on the lighter lands. If a corn crop is imperative then oats should be taken, as in East Anglia we have no evidence as yet that this crop is susceptible, although in Wales oats are attacked by *Ophiobolus graminis* var. *Avenae*, a new variety.

The causal factors responsible for 'lodging' of corn crops have always been debatable points; some attribute it to adverse climatic conditions, such as excessive rain, hail or severe winds; others to excess nutrients such as nitrogen, or to abnormal soil conditions: severe mildew attacks have also been suggested as a possible cause, and one form of it, 'Eye-spot Lodging', is attributed to *Cercosporella herpotrichoides*. Ultimately perhaps this trouble will be circumvented by breeding stiffer strawed resistant varieties.

The losses caused by Yellow Rust are not normally serious, although on farms near the East Coast susceptible varieties such as Wilhelmina are often severely attacked. Brown Rust usually develops later in the season and the losses caused by it are seldom severe. Black Rust is rare and when present develops shortly before harvest.

Dr S. P. Wiltshire. The spread of major crop diseases from country to country.

Evidence of the continued spread of major crop diseases was presented in the form of records taken from recent literature. Spread is taking place in spite of existing plant disease legislation and is not confined to any one country but is broadly scattered throughout the world. Instances were given where appropriate action might have been taken to prevent the introduction of a disease into a country had information been available and its import appreciated. Better intelligence is required about the distribution of plant diseases, their methods of transmission, and trade channels. The tentative suggestion was made that quarantine measures of most countries are of sufficient importance to require the organization of a Plant Quarantine Board to deal with them.

Mr F. C. Bawden. Report of sub-committee on plant disease measurement in the field.

Many plant pathologists are dissatisfied with the present vague method of recording diseases in the field. Accordingly a special meeting of the Plant Pathology Committee was held at Rothamsted on 13 February 1941 to consider possible methods of improvement. A Sub-Committee was formed consisting of Messrs F. C. Bawden, W. Buddin, R. W. Marsh, W. C. Moore, with P. H. Gregory *ex officio*, and a scheme for making a disease survey was subsequently drawn up. It was hoped that a start might be made with the tentative proposals in 1941 and an appeal was made for collaborators. For simplicity it was suggested that the survey should be restricted to six diseases: Loose Smut of wheat, potato Virus and Blight, sugar beet Yellows and Downy Mildew, and apple Brown Rot. Instructions for sampling and forms for recording diseases will be supplied on request. It was important that the survey should be as far as possible of fields selected at random, and records from healthy crops were as important as those from diseased ones.

The success of the scheme depends on the willingness of mycologists to co-operate.

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1. 20 June 1941

The President, W. C. Moore, Esq., M.A., in the Chair

Dr G. R. Bisby and Dr G. C. Ainsworth. On the numbers of fungi.

(The authors did not supply a summary.)

Miss E. M. Blackwell, Miss G. M. Waterhouse and Miss M. V. Thompson. The invalidity of *Pythiomorpha*.

A detailed study of a strain of '*Pythiomorpha gonapodyides*' sent in pure culture to the Botany Laboratory, Royal Holloway College, led to its recognition as *Phytophthora megasperma*.

An attempt to obtain pure cultures of *Pythiomorpha gonapodyides* from other sources brought nothing other than species of *Pythium* or *Phytophthora*.

An enquiry into the characteristics of *Pythiomorpha* (proliferating sporangia, undulating hyphae, etc.) showed that all of these are characteristics of the Pythiaceae as a whole. An enquiry into the records of *Pythiomorpha gonapodyides* between 1909 and 1936 showed that the descriptions are not always of the same fungus and are of species of either *Pythium* or *Phytophthora*.

It is suggested that *Phytophthora* has not been recorded as an aquatic genus because whenever species of *Phytophthora* are found as water moulds they are named *Pythiomorpha*.

Incidentally a fact of interest and significance to plant pathologists is brought to light, viz. that disease-causing species of *Phytophthora* which infect hosts growing in water-logged soil may for long periods lead a saprophytic existence as water moulds in the same way as disease-causing species of *Pythium* live in soil.

Dr C. T. Ingold. *Tetracladium*-like fungi from a stream in Leicestershire.

A number of *Tetracladium*-like fungi were found growing on decaying alder leaves in the bed of a small stream. They are Hyphomycetes with the branched, septate mycelium developed within the tissues of the leaf, and with conidiophores projecting into the water. The conidia in all species are colourless and produced below water. Nearly all these fungi have a branched spore, usually consisting of four long divergent arms. Four of these fungi with branched spores can definitely be referred to described species, namely, *Tetracladium Marchalianum* De Wild., *Clavariopsis aquatica* De Wild., *Lemonniera aquatica* De Wild. and *Varicosporium Elodeae* Kegel, but six other species appear to be new, and for these new species and genera will have to be erected. All these fungi have been grown in pure culture. In most species colonies on malt agar fail to form spores, but sporulation occurs in from 1 to 2 days when a strip of colony is transferred to water. In the different genera the development of the branched spore is so different, although the final result is so similar, that there seems to be here a striking case of parallel evolution. In some genera the branched spore is a phialospore, but in others it is a thallospore. The possible biological importance of the branched spore was discussed. A few species of Hyphomycetes of the alder-leaf flora do not produce branched spores. This occurs in *Fusarium longissimum* Sacc. & Syd., a species very commonly encountered on the leaves. The spores in this fungus, which clearly does not belong to the genus *Fusarium*, are sigmoid or fusiform thallospores 150–300 μ long.

Dr J. RAMSBOTTOM. Dillenius as a mycologist—and some odd notes.

The fame of John Jacob Dillenius as a mycologist rests primarily on his treatment of fungi in his *Catalogus Plantarum circa Gissam sponte nascentium*, 1719. Recently the Department of Botany, British Museum, acquired a large number of Dillenius's drawings, which included a number labelled 'Fungi Catalogi Gissensis & MSS. de ea referentis'. These comprise most of the species referred to in the Catalogue, and a few additional ones. The drawings were exhibited and comments made on Dillenius's ideas about the origin of fungi, which are essentially those of Marsigli, and Lancisi, 1714; the broad basis of the classification he adopted; his genera *Amanita*, *Boletus*, *Erinaceus*, *Morchella*, *Phallus*, *Fungoides*, *Agaricus*, *Peziza*, *Bovista* and *Tuber*; and on the difficulty he obviously had in realizing the variability of such species as *Armillaria mellea*, and the undue weight he placed on fascicular growth.

The first of the odd notes referred to a statement by Linneus in the account of his Lapland Journey. As is well known, this work was first published in 1811 as a translation by J. E. Smith with the title *Lachesis Lapponica, or a Tour in Lapland*. The remark is in Vol. 1, p. 176, and is of interest as adding to the information about squirrels as mycophagists: 'The Laplanders in this neighbourhood [Westbothnia] had set traps to catch squirrels. Each consists of a piece of wood cloven half way down, and baited with a piece of dried fungus with which the animal is enticed. The fungus used for this purpose is an Agaric with a bulbous stalk and crimson cap (*A. integer* β *Sp. Pl.*).'

Other notes referred to a possible British record of *Amanita caesarea* and to *Agaricus exsuccus* Knapp.

REVIEW

Diseases of British Grasses and Herbage Legumes. By KATHLEEN SAMPSON and J. H. WESTERN. Pp. 85, 8 plates and 15 text-figures. Cambridge University Press, 1941. Paper covers, 5*s*. net.

British plant pathology has always suffered from the lack of a really comprehensive and trustworthy treatise dealing with the various diseases that attack crop and other plants in this country. Perhaps this want may eventually be supplied; meanwhile we are glad to get what we can on the instalment plan, and in recent times we have had some valuable contributions. First, some considerable time ago, came Bewley's *Diseases of Glasshouse Crops*; and, in view of subsequent additions to our knowledge of these, due in large part to the researches carried out at the Cheshunt Experimental Station, it may perhaps be permissible to hint here that a second edition of that useful book would receive a warm welcome. Then came Wormald's *Brown Rot Diseases of Fruit Trees*, and not long afterwards, W. C. Moore's excellent *Diseases of Bulbs*. To these has now to be added Miss Sampson's and Dr Western's account of the diseases of British grasses and herbage legumes.

In his foreword to this book, Professor Sir George Stapledon points out that it is the outcome of some twenty years of research and survey work carried out at the Welsh Plant Breeding Station at Aberystwyth, with which the senior author has been associated from the very beginning, Dr Western having joined in it at a later date. It is clear therefore that the authors are fully competent for their task. As they point out in their introduction, the importance of the subject becomes more apparent when it is realized that 'grass' or 'herbage' is not a unit, but consists of a collection of species and strains which have often widely different propensities. Breeders of new types, and propagators of clonal races of improved strains, have therefore frequently to contend with diseases, which, to others, may seem of little importance. The golf-green keeper, that upsetter of the natural ecological equilibrium of 'turf', is another worker whose efforts are often impaired by outbreaks of disease. The farmer himself may suffer seriously from a disease such as Clover Rot. Finally, the plant pathologist is bound to benefit from the additional knowledge concerning some of the more or less uncommon diseases which he may from time to time be called upon to diagnose and treat. There is ample justification therefore for the publication of a work of this kind.

In the section of the book devoted to grasses, the diseases—practically all due to parasitic fungi—are classified under the captions: Smuts, Bunts, Rusts, Mildew, Leaf Spots and Inflorescence Diseases. A note on the systemic infection of species of *Lolium* by fungi of unknown relationships follows. The diseases of seedling and established turf are then dealt with, and the section ends with a brief reference to Fairy Rings. One might demur to the inclusion of Grass Choke (*Epichloe typhina*) amongst the inflorescence diseases, alongside of Ergot (*Claviceps*), although of course the inflorescence sometimes is the seat of the stromata of the systemic fungus, and seed transmission has been established with certainty in *Festuca rubra*. Further, *Sclerotium rhizodes* is a parasite of upland hay rather than of turf; but separate captions for these two diseases would perhaps be hardly worth while, and they are not serious misfits where they stand.

The diseases of herbage legumes (mainly clovers) are dealt with under the headings: Root and Crown Diseases, Miscellaneous Root Diseases, Stem Diseases, Leaf-Spot Diseases, Mildews and Rusts. The flower disease—Anther Mould, due

to *Botrytis anthophila*—is described and the probability of the occurrence of Virus diseases of red clover in Britain is pointed out. Virescence of the carpels in both white and red clover, resulting in failure to produce seed, is alluded to under the heading Diseases of Unknown Origin. Lastly, instances are given of diseases due to mineral deficiency, some of which have become of serious importance in recent years.

The symptoms of the various diseases are described clearly and succinctly, and useful information concerning the causative parasites is supplied. Where control measures are known and are practicable they are briefly mentioned. A very valuable feature is the generous sprinkling of references to previous literature, the authors and titles being assembled in a list more than twelve pages long, at the end of the book. The eight plates contain thirty-five good half-tone photographic reproductions of many of the diseases described, or of mycological details of the parasites, the latter being supplemented by the fifteen text-figures. There is a good index in which the names of the hosts and parasites are printed in heavy type, thus standing out clearly from the other entries.

Altogether, though more in the nature of a bulletin than a substantial book, this account of the diseases of our native herbage plants forms a valuable addition to British phytopathological literature; moreover, its price, especially under present difficult conditions, is a modest one, an incentive rather than a deterrent to the possession of the book.

G. H. PETHYBRIDGE

[The bulletin is issued by the British Mycological Society. This was made possible by a grant from the Agricultural Research Council.]

FUNGUS FORAY, EPPING FOREST

4 October 1941

By J. RAMSBOTTOM

MORE as a token of continued activity than as a serious attempt at field work, a day's foray was held in Epping Forest on Saturday, 4 October 1941. About thirty members and friends met at Chingford, which is conveniently situated for entering the Forest. The season earlier had been exceptionally good, and later there had been a spell of fine dry weather and toadstools were not abundant. As is almost usual when fungi are scarce on account of drought, rain soon made its appearance, but after a heavy shower the weather cleared. The path taken was first into the forest, the edge being then skirted until Fairmead was reached, and thence through the best collecting ground to High Beech. From here a number of the party left; the remainder arranged to have tea and afterwards most walked back to Chingford.

A look-out was kept for *Ecchyna* [*Pilacre*] *Petersii*, which can usually be found on the old hornbeams at Chingford, but without success. Two somewhat weathered specimens of what almost exactly resembled the illustrations of *Amanita Eliae* Quél., in *Bull. Soc. myc. Fr.* XLVI (1930), Atlas, Pl. xxxvi, were collected, but on microscopic examination were found to have the structure of *Amanitopsis fulva*. A tuft of *Hypholoma fasciculare* was found with perfectly yellow gills—the *Clitocybe Sadleri* of Berkeley (Cooke, *Illustr.* 127 [180]): the form is not uncommon when the fungus occurs at the base of wooden palings which are fixed in pavement. As usual, when examined microscopically, it showed a few typical spores. Near High Beech a number of specimens of *Collybia cirrhata* occurred. Cultures made from these by Miss Stephens have produced typically coloured sclerotia but of much larger dimensions than usual in the field. The best find of the day was *Russula solaris* Ferd. & Wing. This species is probably not as rare as would seem from its records. When every *Russula* with a yellow cap is named *R. ochroleuca*, and with masses of that species about, *R. solaris* is likely to be overlooked. In the young stage the cap has the shape and the pectinate edge of *R. foetens*, but it is a smaller fungus and has a bright yellow cap; it is possibly the citron yellow form of *R. pectinata* mentioned by Ricken. Continental mycologists have busied themselves these many years in trying to straighten out the genus *Russula*. It is an interesting commentary on the state of our knowledge that *R. solaris* has been suggested by different workers to

be synonymous with *R. Raoultii* Quél., *R. farinipes* Rom., *R. Queletii* Fr. f. *albocitrina* Barb., *R. aurantiolutea* Kauff., *R. disparilis* Burl., *R. constans* Karst., and *R. citrina* Gill.

Everywhere in the forest decaying specimens, particularly of *Lactarius*, were covered with growths of *Penicillium*. Mr G. Smith later reported that he had isolated two species, *P. brevi-compactum* Dierckx (*P. stolonifera* Thom) and *P. cyclopium* Westl.

The list of fungi is small. The President made note of those met with by his party, but all members present added their share. As was to be expected the opportunity for discussing mycology and the affairs of friends present did not allow the paucity of fungi to spoil a very pleasant day.

The list is arranged alphabetically, as has been recently adopted:

HYMENOMYCETES AND GASTEROMYCETES

Amanita mappa (Batsch) Fr., muscaria (Linn.) Fr., rubescens (Pers.) Fr.
Amanitopsis fulva (Schaeff.) W. G. Sm.
Androsaceus androsaceus (Linn.) Pat., rotula (Scop.) Pat.
Armillaria mellea (Vahl) Fr., mucida (Schrad.) Fr.
Boletus badius Fr., chrysenteron (Bull.) Fr., luridus (Schaeff.) Fr., subtomentosus (Linn.) Fr.
Calocera stricta Fr.
Clavaria cinerea (Bull.) Fr., cristata (Holmsk.) Fr., inaequalis (Müll.) Fr.
Clitocybe aurantiaca (Wulf.) Stud., clavipes (Pers.) Fr., infundibuliformis (Schaeff.) Fr.
Collybia butyracea (Bull.) Fr., cirrhata (Schum.) Fr., fusipes (Bull.) Fr., maculata (A. & S.) Fr., radicata (Rehl.) Berk.
Coprinus micaceus (Bull.) Fr., niveus (Pers.) Fr., plicatilis (Curt.) Fr.
Cortinarius (Dermocybe) caninus Fr., (Telamonia) hemitrichus (Pers.) Fr., (Dermocybe) sanguineus (Wulf.) Fr.
Fistulina hepatica (Huds.) Fr.
Flammula sapinea Fr.
Galera hypnorum (Schrank) Fr., tenera (Schaeff.) Fr.
Ganoderma applanatum (Pers.) Pat.
Hypholoma fasciculare (Huds.) Fr., hydrophilum (Bull.) Fr., lacrymabundum Fr.
Inocybe eutheles B. & Br., geophylla (Sow.) Fr.
Irpex obliquus (Schrad.) Fr.
Laccaria laccata (Scop.) B. & Br., var. amethystina (Vaill.) B. & Br.
Lactarius blennius Fr., mitissimus Fr., serifluus (DC.) Fr., subdulcis (Pers.) Fr., turpis (Weinm.) Fr., quietus Fr.
Marasmius dryophilus (Bull.) Karst., hariolorum (DC.) Quél., oreades (Bolt.) Fr., peronatus (Bolt.) Fr.
Mycena galericulata (Scop.) Fr., galopus (Pers.) Fr., inclinata Fr., polygramma (Bull.) Fr., rugosa Fr.
Nolanea pascua (Pers.) Fr.
Panaeolus campanulatus (Linn.) Fr.
Paxillus involutus (Batsch) Fr.
Phlebia merismoides Fr.
Pholiota squarrosa (Müll.) Fr.
Pleurotus corticatus Fr.
Pluteus cervinus (Schaeff.) Fr.
Polyporus adustus (Willd.) Fr., betulinus (Bull.) Fr., radiatus (Sow.) Fr.
Polystictus versicolor (Linn.) Fr.

Psathyra pennata Fr.
Psilocybe ericaea (Pers.) Fr., semilanceata Fr.
Russula alutacea (Pers.) Fr., atropurpurea Krombh., fragilis (Pers.) Fr., mustelina Fr., nigricans (Bull.) Fr., ochroleuca (Pers.) Fr., solaris Ferd. & Wing.
Scleroderma verrucosum (Vaill.) Pers.
Stereum hirsutum (Willd.) Fr.
Stropharia aeruginosa (Curt.) Fr., semiglobata (Batsch) Fr., squamosa (Pers.) Fr.
Tricholoma albobrunneum (Pers.) Fr., fulvum (DC.) Fr., saponaceum Fr., sejunctum (Sow.) Fr.
Tubaria furfuracea (Pers.) W. G. Sm.

UREDINALES

Melampsoridium betulinum (Pers.) Kleb.
Phragmidium violaceum (Schultz.) Wint.
Puccinia Cirsii Lasch., Violae (Schum.) DC.

USTILAGINALES

Ustilago Scabiosae (Sow.) Wint.

PYRENOMYCETES

Diatrype stigma (Hoff.) Fr.
Diatrypella quercina (Pers.) Cke.
Hypoxylon coccineum Bull.
Melanconis stilbostoma (Fr.) Tul.
Nectria cinnabarina (Tode) Fr.
Sphaerotheca pannosa (Wallr.) Lév.
Stigmatea Robertiani Fr.
Xylaria Hypoxylon (Linn.) Grev.

DISCOMYCETES

Bulgaria inquinans Pers.
Dasyobolus immersus (Pers.) Sacc.
Dasyscypha virginea (Batsch) Fuck.
Helotium herbarum (Pers.) Fr.
Mollisia cinerea (Batsch) Karst.
Orbilia xanthostigma Fr.
Saccobolus violascens Boud.
Stegia Ilicis Fr.

DEUTEROMYCETES

Actinonema Rosae (Lib.) Fr.
Bispora monilioides Cda.
Botrytis cinerea Pers.
Dilophospora Alopecuri Fr.
Penicillium brevi-compactum Dierckx, cyclopium Westl.
Sepedonium chrysospermum (Bull.) Fr.
Septoria Rubi Westend.
Stilbella erythrocephala (Ditm.) Fr.

ANNUAL GENERAL MEETING

13 December 1941

THE Annual General Meeting was held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, at 12 o'clock on Saturday, 13 December 1941, with the President, W. C. Moore, Esq., M.A., in the Chair.

Arising out of the Minutes, the General Secretary gave an outline of the year's programme which had been carried out.

In presenting the Treasurer's Statement, Mr A. A. Pearson said that the general financial position was very good and there was nothing to fear so long as there was no change for the worse in international money matters.

The name of Miss E. M. Blackwell was put from the Chair as the Council's nominee for the Presidency for 1942, and she was elected unanimously. In accordance with Rule 6, the retiring President, Mr W. C. Moore, and his predecessor in office, Dr H. Wormald, were elected Vice-Presidents, and Mr W. Buddin as the third Vice-President.

Mr J. Ramsbottom and Mr A. A. Pearson having consented to continue in office they were again re-elected as General Secretary and Treasurer respectively.

Dr C. G. C. Chesters announced that as he was not at present able to devote the necessary time to the affairs of the Society, he wished to tender his resignation. The President expressed the thanks the Society owed to Dr Chesters for the work he had done during the past five years, and the General Secretary said that, until overburdened with A.R.P. and other duties, Dr Chesters had been energetic in the affairs of the Society and an admirable colleague in every way; he hoped that in brighter days he would return to office. The meeting showed its appreciation of Dr Chesters's services.

The President then put forward the name of Dr G. C. Ainsworth as Secretary for 1942, and this was carried unanimously.

Mr J. Ramsbottom, Dr B. Barnes and Dr H. Wormald were re-elected as Editors. As members of Council, Mr S. D. Garrett, Dr A. Smith, Mr G. Smith and Mrs E. W. Mason were elected in place of the retiring members, Dr M. Brett, Miss M. W. Rea, Miss F. L. Stephens and Miss E. M. Blackwell, Miss Blackwell as President being *ex officio* a member of Council.

The Plant Pathology Committee nominated Dr G. R. Bisby, Mr M. H. Moore and Dr J. H. Western to replace the retiring members, Messrs R. V. Harris, E. W. Mason and Miss E. M. Wakefield; this was agreed.

The President then proposed from the Chair that Miss E. M. Wakefield and Mr T. Petch be elected Honorary Members. Miss Wakefield had served as Secretary for many years, and both were well qualified under both headings mentioned in the Rules, 'Honorary Members shall be persons of pre-eminence in Mycology, or who have rendered special service to the Society.' The proposal was received with acclamation.

The General Secretary then explained the suggestions for the 1942 programme. It would probably be possible to hold at least three meetings for the reading of papers, two in the spring and one in the autumn, and one or more day forays in the autumn or possibly a week-end one. The Annual Meeting would best be fixed for 12 December 1942.

It was decided that, generally speaking, Saturday was the most suitable day for indoor meetings.

The meeting then adjourned until 2 p.m. when the President delivered his Address on 'Organization for Plant Pathology in England and Wales—Retrospect and Prospect'.

Following the Address, Mr Ramsbottom thanked the President for his stimulating remarks and paid tribute to the services Mr Moore had given to the Society both before and particularly during his term of office. He knew that the President thought some of his remarks controversial and it might be profitable to discuss these when members had had an opportunity to read them at leisure. Doubtless before long much would have to be readjusted, and it was desirable that mycologists should be ready to make the most of changed circumstances. As a Society their object was the furtherance of the study of mycology in all its branches. In asking that the meeting should thank the Linnean Society for its continued hospitality he said that it was appropriate that they should bask in the benevolent regard as it were of that great mycologist and pathologist the Rev. M. J. Berkeley.*

At the Council meeting it was decided that except in special circumstances, titles only shall be published in the *Transactions* of papers read at meetings, when the full paper has appeared or is shortly to appear. Summaries of papers given at the meetings are not to contain more than 250 words.

J. Ramsbottom

* In the Meeting Room of the Linnean Society there is a portrait of Berkeley by John Peel, presented by subscribers in 1878, when Berkeley was seventy-five.

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 30 JUNE 1941

Receipts	£	s.	d.
1940			
1 July—Balance brought forward	603	7	10
2 July—Grant from Agricultural Research Council for Monograph of Diseases of British Grasses	50	0	0
1941			
30 June—Subscriptions to date	250	9	0
Gifts to Printing Fund	3	1	9
Sale of *Transactions*:			
Current Vols.	102	6	0
Back Vols.	76	0	7
Sale of Reprints	8	11	6
Profit from Sale of C. Rea's *British Basidiomycetae*	4	15	11
Deposit Interest	2	14	10
War Loan Interest	17	10	0
	£1118	17	5

Payments	£	s.	d.
1941			
30 June—Cambridge University Press, Cost of Vol. XXIV, *Transactions* and Reprints ...	529	4	8
Postage, etc.			
Treasurer	2	10	0
Secretary		10	0
Sec. Pathological Committee	2	10	3
Editor	2	9	1
Sundry Printing	11	16	0
Fees of Meetings		10	0
Purchase of *Transactions*	1	10	0
Subscriptions refunded	3	3	0
Balance in hand and on deposit	564	14	5
	£1118	17	5

CAPITAL ACCOUNT—Robinson Bequest, £50 }
Cheesman Fund, £150 } invested in $3\frac{1}{2}$% War Loan
Printing Fund, £300 }

A. A. PEARSON, *Hon. Treasurer*

Examined and found correct, F. G. GOULD

PRESIDENTIAL ADDRESS

ORGANIZATION FOR PLANT PATHOLOGY IN ENGLAND AND WALES—RETROSPECT AND PROSPECT

By W. C. MOORE, M.A.

The term Plant Pathology ought to be applied to a subject the study of which should include any derangement of the plant, whether of vegetable, animal or mineral origin. Unfortunately it has been used very loosely, and for many years past has often been regarded as having a purely botanical connotation, and as synonymous with what is vaguely called economic mycology. Most emphasis will not unnaturally be given in this address to plant pathology in its mycological aspects, and no attempt will be made to avoid using the customary terminology of the subject, but it is not my intention to deal with mycology in its strict and literal meaning. On the other hand, I must confess to employing the terms plant pathology and plant pathologist in the narrowest as well as the broadest sense, but I hope without confusing the issue.

I suspect that most of you will wish to question at least some of what I shall have to say, but I doubt if anyone will dispute the claim that the Rev. Miles Joseph Berkeley was the father of plant pathology in Great Britain, just as he was the founder of mycology here. He was a contemporary of Unger and so grew up during the period when fungi were regarded as entophytes originating from diseased host tissues. It is all the more remarkable, therefore, that he shared with Kühn and de Bary, who were more than twenty years his juniors, the leadership of a new school of thought which appreciated and taught the true nature and function of parasitic organisms. Berkeley's articles on vegetable pathology, begun in the *Gardeners' Chronicle* in 1854, and continued at intervals in serial form until 1857, set forth his ideas and those of the day in simple language. He still classified diseases by the old method into 'genera' according to symptoms, but his contributions were always to the point and were addressed in the main to the practical man. There were over 170 of the articles altogether, and it is a great pity they were never published separately. Maybe it is still not too late to do so, for they have a considerable historical importance, and would find a worthy place alongside the Phytopathological Classics issued in recent years by the American Phytopathological Society. Nowadays, Berkeley's articles have their

counterpart in the leaflets on plant diseases issued by the Ministry of Agriculture and Fisheries and other bodies. As pointed out in the presentation address when he received the Medal of the Royal Society in 1863, Berkeley was at the time the one and only English authority on vegetable pathology.

M. C. Cooke was twenty-two years younger than Berkeley, and was first and foremost a mycologist, but he, too, left his mark on plant pathology. One of his duties on being placed in charge of the Lower Cryptogams at Kew in 1880 was to report on questions about plant diseases submitted to Kew. Moreover, among the many books and pamphlets he published, his *Fungoid Pests of Cultivated Plants*, first published in parts in the *Journal of the Royal Horticultural Society* and issued as a book in 1906, is still indispensable to plant pathologists seeking information about British diseases of ornamental garden plants. Nevertheless, it was the third of the outstanding older men, the well-known botanical artist Worthington G. Smith, who provided English students with their first general book on plant diseases. His *Diseases of Field and Garden Crops* appeared in 1884. It was based on a series of addresses delivered at the British Museum (Natural History) at the request of the Institute of Agriculture and was rather limited in scope, but it served a very useful purpose.

Two other names, H. Marshall Ward and George Massee, will always be associated with English plant pathology in the latter part of the nineteenth and the beginning of the twentieth centuries. Indeed, Marshall Ward has been named the greatest of English plant pathologists. His outlook was determined by the experience he gained, first as a student under Sachs and de Bary, and later as an investigator of the Rust that decimated the coffee plantations of Ceylon in the late seventies, and, with Sorauer, he became the leading predispositionist of the period. Ward's studies in parasitism, carried out before and after his appointment as Professor of Botany at Cambridge in 1895, have been claimed to have formed the basis of all later investigations into the nature of susceptibility and immunity in plants.

For many years Massee was essentially a mycologist, but after 1893, when he succeeded Cooke in charge of the Lower Cryptogams at Kew, he turned more and more to pathological work. His *Text Book of Plant Diseases* became a landmark in the history of the subject in this country. It was first published in 1899 and passed through several editions during the thirty years or so it retained its place.* Massee formed a link between the older generation who relied on external morphology and the modern school with its advantages of refined technique and methods of pure culture, and in assessing the merits of his work, due allowance must be made for the rapid advances that

* In 1910 it was expanded and reissued under the title *Diseases of Cultivated Plants and Trees*.

were constantly being made in pure culture work. Massee also acted as adviser in plant diseases to the Board of Agriculture. There was then no official phytopathological service, and it is perhaps no exaggeration to say that before 1900, plant pathology in this country was served, in the main, through the zealous diversions of a clergyman and an artist, the predilection of a professor of botany, and the native appetite of a mycologist or two.

This state of affairs in general continued for some years into the twentieth century, but already the beginnings of a new order of things were becoming apparent in the intensive studies of fruit-tree diseases begun when E. S. Salmon migrated from Kew to Wye in 1906. Nevertheless, it was the passing of two Acts of Parliament, one in 1907 and one in 1909, that provided the greatest stimulus to the development of plant pathology in England and Wales.

The first of these was known as the Destructive Insects and Pests Act of 1907. Long before this, under the Destructive Insects Act of 1887, Parliament had empowered first the Privy Council, and later the Board of Agriculture, to issue such Orders as were necessary to keep the Colorado Beetle out of the country. The new Act extended the powers of the Board of Agriculture by enabling it to deal with insect pests other than Colorado Beetle, as well as with fungus diseases of crops, trees and bushes. A small staff of inspectors was created to administer the practical working of the Act, and in 1913 J. C. F. Fryer was appointed to the new post of Entomologist to the Board. For the time being there was no corresponding mycological appointment, guidance on matters relating to plant diseases still being obtained from Kew.

The second Act was called the Development and Road Improvement Funds Act of 1909. As a matter of general policy it was decided that the funds rendered available for aiding agriculture under this Act should be used in the main to subsidize existing or newly founded scientific institutions for two purposes, namely, to carry out research into various branches of agricultural science, and to develop advisory work and local investigations within certain comparatively large areas or provinces. The organization envisaged under this scheme gradually took shape between 1909 and 1914. For the recruitment of personnel for the service a system of research scholarships was introduced, and later, in 1920, a scheme of travelling fellowships was inaugurated to enable senior research workers to keep abreast of research in agricultural science abroad.

Among other things funds were provided for research and advisory work on plant diseases and pests. Three institutes were founded to deal mainly with fundamental research on plant diseases and pests: one for plant pathology at the Royal Botanic Gardens, Kew; one for agricultural entomology at Manchester University; and one for

agricultural helminthology at Birmingham University. As time went on scientific workers in plant diseases and pests were also appointed to the staffs of specialized research stations, including those at Long Ashton, East Malling and Cheshunt. For the local investigation and advisory work specialists in economic entomology and economic mycology were attached to certain universities and agricultural colleges in England and Wales, and they became members of the staffs of those institutions.

The smooth and rapid working out of the scheme was inevitably impeded by the exactions of the Four Years' War and post-war reconstruction. Nevertheless, the scheme evolved prior to 1914 governed subsequent development continuously, and the organization of to-day is the outcome of a plan conceived some thirty years ago.

Before describing the present position it may be advantageous to refer briefly to two of the earlier developmental changes that occurred.

In May 1917, a sub-committee of the Technical Committee of the War-time Food Production Department was formed to advise the Department on questions relating to pests and diseases. This sub-committee consisted of the leading mycologists and entomologists in the country, with the Entomologist to the Board of Agriculture as convener. One of its activities was to inaugurate a plant disease survey by means of a system of monthly reports, prepared by specially qualified honorary correspondents in all parts of the country. These reports were collated, summarized and issued the following year as a Miscellaneous Publication of the Board of Agriculture, which, in point of fact, proved to be the first of a series of reports on diseases and pests of crop plants that have since been issued from time to time.

In 1918 the Plant Pathology Laboratory that had been founded at the Royal Botanic Gardens, Kew, four years before, was reorganized. The *research* side of it was combined with the fundamental entomological work previously carried on at Manchester* and the whole was transferred to Rothamsted, Harpenden, in order to provide the nucleus of a national Institute of Plant Pathology, which was intended to form an entirely separate unit of the Rothamsted Experimental Station, though ultimately responsible to the Director and Managing Committee of that Station. As a matter of fact the independent Institute envisaged never came properly into being, and although kept administratively distinct for a time, its functions were merged into those of the Station and its two components became merely departments of Rothamsted. The *administrative* and *advisory* side of the Kew Laboratory remained at Kew for a time, but became

* The research on agricultural helminthology carried out at Birmingham University was ultimately incorporated with the work of the Department of Helminthology in the London School of Tropical Medicine.

a constituent part of the Board of Agriculture, under the direction of J. C. F. Fryer, the Board's Entomologist. A new post of Mycologist to the Board was created at the same time and A. D. Cotton was appointed to it. The Laboratory was transferred to Milton Road, Harpenden, during the period October 1920–April 1921, and in October 1923 G. H. Pethybridge succeeded Cotton as the Board's, by then the Ministry's, Mycologist. One of the post-war functions of this Laboratory was to assume responsibility for the plant disease survey work begun in 1917, for the Food Production Department and its Technical Committee had been a purely temporary organization called into being by the exigencies of the war and dissolved after its conclusion.

Enough has perhaps been said to give an idea of the evolutionary history of the plant pathology service in England and Wales. The scheme was in more or less full working order by about 1923. Since that time little increase has occurred in the advisory personnel until the last year or so, but the research side has slowly and steadily expanded, both within and outside the framework of the original scheme.

At the present time there are two distinct sides to the phytopathological service, the official and the non-official.

The official side is staffed by civil servants, and consists of an administrative unit in the Horticulture Branch of the Ministry of Agriculture, some forty members of the Ministry's Inspectorate, and the Plant Pathological Laboratory at Harpenden. The first two groups are responsible for the administration of existing internal legislation in regard to diseases and pests, and for the extensive work necessary in the certification for health of imported and exported consignments of plants, an aspect of the subject that lies outside the scope of this address. It need merely be stated that these duties occupy only part of the time of the officers concerned. The primary functions of the Plant Pathological Laboratory are to undertake the scientific work required for the efficient administration of the Destructive Insects and Pests Acts, and to advise on the need for research and advisory work on diseases and pests, and the means by which it can be carried out; in short, to act as the co-ordinating centre for the whole service. It has a small staff of entomologists and mycologists, and among other things is responsible for the preparation of official leaflets and memoranda on diseases and pests, and is in charge of the intelligence system by which information regarding the distribution, spread and economic significance of diseases and pests is collected and distributed. The laboratory also shares to a limited extent in both research and advisory work. A significant innovation on the research side during the last few years is that research workers have been directly attached to the laboratory for the investigation of specific projects under the direction of the Ministry's Mycologist.

The non-official side of the service includes mycologists and entomologists attached to the Research Stations, and the corps of Advisory Mycologists and Entomologists on the staffs of the Universities and Agricultural Colleges. None of these workers is in any sense a civil servant. For their maintenance the Development Commissioners, through the Ministry of Agriculture, make an annual contribution to the funds of the institutions at which they are stationed. Some of the research stations have substantial sources of income apart from the Development Fund grant, while others are almost entirely dependent on the Fund. At the same time, all the contributions made are purely grants-in-aid and the State has no direct administrative responsibility. Grant-aided research workers in plant diseases and pests are stationed, for instance, at the Rothamsted Experimental Station, the two fruit stations at East Malling and Long Ashton, the Station for glasshouse problems at Cheshunt, and the Horticultural Research Station, Cambridge. Special provision was made for the study of virus diseases by the establishment at Cambridge in 1926 of the Potato Virus Research Station, now the Plant Virus Research Station. Two years later a special group of workers was organized, and stationed at Rothamsted, to investigate the fundamental nature and properties of plant viruses. This scheme was aided until 1933 from the funds of the Empire Marketing Board, but is now maintained by a special grant from the Development Fund. Other special, as distinct from normal, annual grants may also be made from the funds of the Development Commission and of the Agricultural Research Council to research stations and university departments for various specific purposes.

The specialist advisory service in plant pathology is provided for wholly from the Development Fund. Before the outbreak of war in 1939, it consisted, as a rule, of one mycologist and one entomologist in each of thirteen agricultural provinces, though in one province the advisers had permanent assistants, and in several others temporary assistants had been appointed for special purposes. As a war-time measure, the service has been expanded by the appointment of one or more assistant mycologists and entomologists in most provinces and, on the entomological side, by the organization of special teams of junior assistants for wireworm survey work. The advisers diagnose troubles for growers in their provinces and prescribe suitable treatment, act as intelligence officers of the Ministry for diseases and pests, and carry out investigations and experiments on what, theoretically, should be local problems. It should be realized that a considerable amount of advisory work on plant diseases and pests is also done by county staffs; that is, by the horticultural and agricultural officers of the County Agricultural Education Authority. To this extent, therefore, these county organizers and instructors are part of the non-

official phytopathological service. In point of fact, the salaries of these officers are largely state-provided.

Such, in brief, is the general system as it exists to-day in this country. A few other activities are state-aided through the Ministry of Agriculture, including the work of the Official Seed Testing Station at Cambridge, which, among other things, provides information to inquirers about the presence or absence of parasitic organisms on certain kinds of seeds. Important contributions are made by various other unrelated, but state-aided organizations. The Advisory Council of the Department of Scientific and Industrial Research, for instance, is responsible for the maintenance of various stations where plant pathological research is carried out. These include the Low Temperature Station at Cambridge and the Ditton Laboratory at East Malling where, among other things, problems of disease in relation to the storage of fruit and vegetables are investigated; the Pest Infestation Laboratory at Slough, for studying pests of stored products; and the Forest Products Research Laboratory at Princes Risborough, where the causes and conditions of decay in timber and the problems of wood preservation are studied. The pathology of forest trees, on the contrary, is in the hands of a distinct body, the Forestry Commission. Mention must also be made of the pathological work carried out on behalf of the Royal Horticultural Society at Wisley; the provision of funds by commercial and other bodies for research along special lines, as, for example, the investigation of sugar-beet diseases; and lastly, but by no means least, the ever-growing influence of the expanding research and selling organizations of commercial firms producing pest control products.

Behind all this organization and, of course, vital to its success, are the University Departments of Botany. In addition to normal undergraduate training, and the results of research carried out by the staff and graduates of the University, there are the post-graduate schools for training agricultural research scholars and overseas workers, and thus ensuring continuity in recruitment to the phytopathological service as a whole. On the mycological side these have been built up in particular by F. T. Brooks at Cambridge and by W. Brown at the Imperial College of Science.

The Imperial Mycological Institute, which is primarily concerned with the co-ordination of mycological and plant pathological work in the overseas parts of the Empire, is having an increasing influence in home phytopathological matters. If I say nothing of this, however, or of the continued help given by the mycologists at Kew and the British Museum, not to mention their opposite entomological numbers, it is not that I am unmindful of their importance in the scheme of things, but rather that I desire to distinguish clearly between the study of plant diseases and the study of fungi and insects as such.

It will readily be conceded by all who know the facts that the existing service has been of great and vital assistance during the past thirty years or so. It may therefore be more profitable to refrain from extolling its strength in order to spend more time in probing its weaknesses and considering possible ways in which its efficiency might still further be increased.

On the whole the needs on the horticultural side have been more adequately met than those on the agricultural side. Perhaps the most urgent need is to remove the serious 'bottle-neck' that exists between science and practice. A great volume of knowledge is available, and much of this should long ago have passed into general routine practice. It never will do so, however, until the grower has been convinced by demonstration, and until he appreciates the meaning of what he is expected to do and why it should be done. This involves personal contact, which can be made only to a very limited extent by a handful of specialist advisers. Mere numbers, of course, do not provide the answer. Nor do leaflets, bulletins, broadcasts and other forms of publicity. These can and must play their part, but they become really effective only after personal contact has been made and understanding reached. Nor can one look with equanimity on the prospect of advisory work passing largely into the hands of organizations whose interests must necessarily be influenced by the need and desire to sell their own products.

It would seem that the gap between the county organizer and instructor trained in agriculture or horticulture, and the specialist economic mycologist or entomologist, is too big. It is surely just as important to understand the principles and practice of hygiene and disease control as it is to understand the principles and practice of crop cultivation. Many growers fail to reap the full reward of their undoubted knowledge and skill in growing their crops because of the ravages of common diseases and pests. Yet it is not that these growers are incapable of understanding or profiting from plant pathological advice. In matters of cultivation they can often teach as well as learn from their scientific advisers, and with proper explanation and demonstration in the field they would soon be capable of understanding and discussing plant pathological matters. If the truth of this is granted—and there is surely no reason, for instance, why one who fully understands the art of pruning should not fully understand the significance of mummied fruits attacked by Brown Rot—then it must also be admitted that an organizer or instructor, trained in plant pathology and having a working knowledge of agriculture or horticulture, is just as much a necessity as one trained in agriculture or horticulture and having a working knowledge of plant pathology. The main function of such an organizer or instructor in plant pathology should be to see that the results of research are put

into practice, and the measure of his success in doing this will depend on the extent to which he is able to pass on the knowledge he himself possesses. Clearly, he does not need the higher training of the advisory mycologist or entomologist, but he should be familiar with the symptoms and control of all the troubles that lead to economic crop losses, whether they are due to bacteria, fungi, insects, viruses or other causes. All this implies a more general and less specialized knowledge, the possession of which will lead to an easier approach to the grower, facilitate the ever more insistent need for closest co-operation between the varied interests that are concerned with plant pathology, and obviate the practical difficulties that confront the specialist officer who may not, or dare not, deal with matters outside his own particular subject, however competent he may be to do so.

Another source of weakness in the present system is the loose connexion between different components of the service. Of the two distinct types of advisers, one—the local organizer or instructor in general agriculture and horticulture—is responsible to the County Agricultural Education Authority and the other—the specialist economic mycologist and entomologist—to the University or Agricultural College where the provincial advisory centre is stationed. Collaboration between the two is inevitably almost wholly dependent on personal relations. In the same way the link between the specialist advisory officers and the Plant Pathological Laboratory is a slender one. Advisory officers are appointed by a university or college and are subject to the authority of those bodies. Their only statutory obligations to the Ministry of Agriculture and the central laboratory are to attend one or two conferences a year, and to prepare monthly and annual reports on the prevalence of diseases and pests in their provinces and on the work carried out during the year. Although these statutory obligations are important and are, indeed, satisfactorily fulfilled, something more than this is required, and, happily, informal collaboration is, in most instances, a great deal closer than is implied by this statement. On the other hand, there is little or no direct collaboration between the county organizers and instructors and the central laboratory.

As regards research, it would seem that just as it is illogical to try to divorce 'fundamental' from 'applied' research, so it is almost impossible to distinguish between local and national disease and pest problems. The local investigations carried out by the advisers have been determined largely by the kind of crops grown in their provinces; and for the most part advisers have become specialists on the diseases or pests of a limited range of crops. With the general tendency towards division of work on a crop basis there is justification for merging this aspect of advisers' activities with the work of the research

stations, provided that that work is reorientated to give as much emphasis to field as to laboratory and plot experiments.

It is difficult to avoid the impression that the general research programme has expanded in some respects in a rather haphazard fashion. This is perhaps inevitable when the general policy adopted is one of decentralization and of grants-in-aid without direct administrative responsibility. Nevertheless, grants can no longer be decided as in the past on a general principle, such as that of helping already existing institutions on a £ for £ basis. With the passage of years income received from the State has in most instances steadily overtopped that from other sources, and assistance must now depend on the sum required for the effective execution of an approved programme of work, even if this involves the whole income of an institute being derived from the State. Thus, there now seems to be no insuperable objection to the establishment of one or more national institutes fully maintained by the State, though not staffed by civil servants.

With the above considerations in mind and without unduly or unnecessarily disturbing the existing framework of organization, I am tempted to visualize the existence of a closely knit Phytopathological Service, each component of which would cover the whole field of plant pathology in the widest sense of that term. The Service would thus include economic mycologists and entomologists, virus workers, helminthologists, bacteriologists and agricultural biochemists, as well as those concerned more particularly with non-parasitic troubles. It would consist of an official side with its Plant Pathology Laboratory and inspectorate, and a non-official side comprising one or more essential national institutes, a chain of research stations, substations and observation posts organized on a crop basis, and a large corps of advisory plant pathologists or plant doctors, attached to the County Agricultural Education Authority.

The central Plant Pathology Laboratory would be a State building, fully equipped and staffed for co-ordinating every aspect of the work. In essentials its activities would differ little from those at present undertaken and outlined above, but an appreciably enlarged staff would provide much-needed scope for planning research, improving publicity, organizing co-operative trials and pest control campaigns, increasing the value of the intelligence system for obtaining information about the prevalence and intensity of disease, and above all for maintaining the closest possible contact with both field and laboratory work throughout the country. For these purposes the assistance of a biochemist, statistician, virus worker, bacteriologist and helminthologist would be needed in addition to mycologists and entomologists.

This central laboratory would be situated within easy reach, and preferably within the extensive grounds, of one or more National

Institutes for which there is undoubtedly a need. Great strides have been made in virus work in the last fifteen years, but little or no attention has been given to bacterial plant diseases, except in the botanical departments of the Imperial College of Science and Cambridge University, and at the East Malling Research Station. The present demand from plant pathologists in all parts of the country for assistance in diagnosing both bacterial and virus diseases cannot be satisfied without making serious inroads into the normal work of the few who are in a position to help, and whose time for research should not be taken up by routine diagnostic work. A similar state of affairs is now arising with regard to deficiency diseases. I would therefore suggest the establishment of one or more institutes where research on the more fundamental aspects of these subjects can be centralized, and where diagnostic work can freely be undertaken. These institutes would be quite distinct from the ordinary research stations. On the one hand, they would be more directly concerned with the causal agents of disease than with the diseases themselves. On the other hand, they would provide a source from which plant pathologists in general could readily obtain identification of bacteria and viruses, much in the same way as Kew and the British Museum have for many years provided invaluable help to economic mycologists in the identification of fungi. Indeed, there is much to be said for gathering together the work on fungi under a single roof. A national station for testing proprietary pest control products would also be situated appropriately among this cluster of buildings.

The Research Stations would be organized on a crop basis, and each would have its Department of Plant Pathology. There might, for instance, be different stations for cereal and root crops, potatoes, vegetables, fruit, and ornamentals. Each station would be situated in or near the most important area where the particular crops to be investigated are grown. In order to carry out the local investigations previously assigned to the specialist advisory officers, and to study the effect of local climatic and soil factors, each main station would have substations in different areas. If the main fruit station for the eastern half of the country were situated, for instance, in Kent, a substation would certainly be needed in the Wisbech area. In some instances the substations might be substantial buildings more or less fully staffed; in others they might be much smaller, but substantially built, field laboratories, or merely observation posts involving the use of a room at a farm institute or college as headquarters during a few weeks' field observations. The exact composition of the plant pathology staff would vary from station to station, but economic mycologists and entomologists would probably be essential to all. Advantage would also be taken of individual propensities. At the main station the staff would tend to include those with leanings towards laboratory

work and plot experiments. Those more disposed to field work would be in charge of the substations and would also act as liaison officers between the research stations and the corps of advisory plant pathologists or plant doctors, assisting for instance in co-operative trials, in demonstrations, and in diagnostic work on the less common diseases and pests. At the same time they would act as intelligence officers on behalf of the Plant Pathology Laboratory.

In addition, each research station would have its publicity or public relations department, which would be responsible, among other things, for translating the results of the research into practical recommendations, for co-operating with the central Plant Pathology Laboratory in the preparation of leaflets, bulletins and other forms of publicity, and for organizing regular refresher courses for the corps of plant pathologists.

The qualification necessary for the plant pathologists or plant doctors would be a diploma, equivalent perhaps to the National Diplomas in Agriculture and Horticulture. In awarding such a diploma it would be essential that practical ability should count as much as theoretical knowledge. County boundaries do not form a natural agricultural or horticultural division, but administratively these plant pathologists would perhaps most conveniently be attached to the County Agricultural Institutes, the personnel of which is already largely maintained by the State. The number ot appointments would vary from county to county. The duties of these pathologists would be to get the news across to the grower by demonstrations, by meetings and lectures, and above all by personal explanation in the field or on the allotment. They would, in short, be county instructors, not in agriculture or horticulture, but in plant pathology, using the term in its widest sense; and they would be specially trained for that purpose. The higher posts in the county organization would naturally be open to them. In addition, these plant pathologists would be closely linked, on the one hand with the public relations departments and the individual officers of the research stations, and on the other with the central Plant Pathology Laboratory. They would, indeed, become the main source of intelligence information regarding the prevalence and intensity of diseases and pests.

One other point: closer co-operation between the general service and the more specialized auxilliary services is both desirable and possible. It is quite wrong, for instance, to assume, as is sometimes done, that the industrial problems of potato storage begin only when the tubers are clamped, or that the claims of fruit diseases pass in some mysterious way from the realm of the horticultural pathologist to that of industrial research as soon as the fruit is picked.

Recruitment to the service as a whole would follow much the same course as at present, except that better provision is needed at most

Universities for adequate training in the study of virus and bacterial diseases. In addition, new and special courses would be required at the County Agricultural Institutes and at Agricultural Colleges in order to ensure a continuous flow of suitably trained plant doctors. It is perhaps scarcely necessary to add that the success of any such phytopathological or other agricultural service must depend, in the long run, on improved education from an early age of those who are to take up farming or gardening pursuits, and more attractive prospects in these industries after the war.

For any phytopathological service to be effective and successful, active official co-operation between the different components of it is essential, but the personal and unofficial relations between the individual members of the service also play a big, if not a decisive part. I would therefore like to turn for a while to an entirely different aspect of my subject. There are a number of associations that exist for the welfare of agricultural research workers in this country. Among them are the Agricultural Education Association, the Horticultural Education Association, and the Association of Scientific Workers, all of which include plant pathologists among their members, but the only bodies that attract the majority of plant pathologists are the Association of Applied Biologists and our own Society.

From its earliest days the British Mycological Society has given every encouragement to the plant pathologist. It was not surprising therefore that when, at the Annual General Meeting at Baslow in September 1919, the need for the Society to take a more active part in the development of plant pathology in Great Britain was urged, the first reaction of members was to emphasize, not for the first time, that the Society already included in its scope *all* branches of mycology. In spite of this, three months later a special subcommittee was appointed by the Council to deal with questions of interest to plant pathologists. It consisted of six members, including the President and Secretary, with F. T. Brooks as Chairman and A. D. Cotton as Secretary. The personnel of the subcommittee was enlarged from time to time by co-option, and ultimately consisted of twelve members, who remained continuously in office until 1930. At the Annual General Meeting at Whitby in September of that year the subcommittee was reconstituted and its future discussed, and at Belfast the following year it was decided to add to the rules of the Society one defining the status and aims of the Plant Pathology Committee, as it was then to be called. The Committee was given an exceptionally large measure of autonomy, and its new constitution ensured the advantages to be gained from regular but not too violent changes of personnel.

Since its formation, and especially in recent years, the Committee has materially assisted the development of plant pathology and, it

might be added, of mycology in this country. For the past eighteen years it has organized an annual phytopathological excursion, and since 1933 has arranged one of the annual winter meetings of the Society, at which the programme has been devoted to discussions or papers of phytopathological interest. In 1929 the Committee completed the compilation and publication of a *List of Common Names of British Plant Diseases*, and this undoubtedly acted as a stimulus to the preparation of similar lists in different parts of the Empire and elsewhere. A second edition appeared in 1935 and a third is in preparation. Curiously enough, although the primary object of the work was the standardization of the common names of diseases, the increasing value and importance of the *List* lies in the standardization of the scientific names of the pathogens. Not only have over forty Societies, Institutes and Offices in this country agreed to use the recommended names of fungi in their official publications, but the scientific names in the *List* have evidently often been copied without hesitation in foreign literature, and they have also been chosen to serve as a foundation for a list of Scandinavian diseases now being compiled. There is therefore some point in suggesting that the Society, as distinct from the Committee, might assume a more direct interest in the future of the *List*. This applies even more to another very important activity initiated by the Committee in 1935, when it was decided to organize the compilation of lists of individual groups of fungi, such lists to be arranged on a common pattern and to include all records of British fungi referred to in British or foreign works. Lists of British Pyrenomycetes, Ustilaginales, and Hyphomycetes have been published during the last fourteen months, and every encouragement should be given to ensure that the task is completed. The work involved is necessarily long and arduous, and its importance is perhaps not yet fully realized, but I look forward to the time when all the lists have been prepared, brought up-to-date, co-ordinated—as they readily can be—and published in one or more volumes containing all the records of all British fungi.

Two other activities of the Plant Pathology Committee deserve mention. Last year the question of proprietary prophylactic products was thoroughly discussed. The subject proved far too wide to be dealt with solely by the economic mycologist, and it was referred to a Joint Committee appointed by the Plant Pathology Committee and the Association of Applied Biologists. Within a surprisingly short time the Joint Committee prepared a comprehensive report in which definite proposals for the official testing and recognition of proprietary pest control products were put forward, and this report has been submitted to the Ministry of Agriculture and has been accepted by them as a basis for further discussion. Encouraging progress has also been made during the last few months in a new effort intended ultimately

to provide accurate information about the prevalence and intensity of plant diseases in this country.

From this brief account of the activities of the Committee it is clear that those interested in applied mycology have taken full advantage of the facilities so generously afforded by the Society and have benefited accordingly. In view of this, it may at first sight seem paradoxical, if not ungrateful, for a plant pathologist—and especially one who has been closely associated with the Committee—to suggest that a continuance or even further extension of those facilities may in future not be the best course either for the plant pathologist or the mycologist. Two things seem clear: one that the Plant Pathology Committee has sometimes strayed into ways more fitly those of the Society as a whole, and the other, that at times its work has been hampered and restricted by the rather narrow paths it must necessarily follow. Applied mycology can at most form only a part of plant pathology. Even if plant bacteriology is legitimately regarded as coming within its meaning, we are faced with the fact that little help and encouragement have been given by anyone to the very few who have studied bacterial diseases in this country. The Society can naturally not expect any close allegiance from those primarily interested in viruses and virus diseases, and however far the meaning of the term mycology is stretched it cannot embrace the vast and much neglected field of nutritional and other non-parasitic disorders.

When the Association of Applied Biologists was founded, one of its primary objects was 'to provide and advance the science of Economic Biology in its agricultural, horticultural, medical, and commercial aspects', and it soon became the recognized society for all British workers interested in applied biology. To a large extent the meetings of the Association may be said still to conform to the original purpose, but it seems to me that this is not now reflected either in the membership or in the *Annals of Applied Biology*. The great majority of the members are concerned in one way or another with the pathology of plants, and it is this subject that has furnished by far the greater part of the material published in the *Annals* during the past ten or twelve years.

There is inevitably much overlapping between the existing functions of the two bodies to which most of our plant pathologists belong. This duality of purpose, the limited field of plant pathology covered by the Plant Pathology Committee, the undeniable trend within the Association of Applied Biologists and various other reasons into which I need not go now, have led me to what is a purely personal conviction, namely, that in the long run the future of plant pathology and mycology in this country would best be served if these two bodies merged into one. Sacrifices would be necessary, as they usually are when reforms are made, but I believe the gains would more than

offset them. On the one hand, the Plant Pathology Committee would cease to exist as a more or less autonomous part of the British Mycological Society. On the other hand, it would be necessary for the Association of Applied Biologists to recognize and admit its changing development by deliberately setting out to become an association of all those interested in the pathology of plants. I feel sure that from a union such as is suggested there could indeed come a powerful Society or Association of Plant Pathologists in the widest and correct sense of that term. With an influential *Journal* or *Annals of Plant Pathology*, and a close liaison on the one hand with the British Mycological Society, and on the other with the Royal Entomological Society, it could play a leading part in developing and co-ordinating the various subjects that constitute the wider conception of plant pathology.

It is not, I think, irrelevant to add a few comments on a possible future for our own Society, in the light of the suggestion made. Any considerable reduction in the phytopathological activities of the Society would make a gap, it is true, but one that I feel sure could soon be filled. Moreover, although about 40 % of present members resident in Britain are professional plant pathologists, I believe few of them would relinquish their membership. The mycological activities of the Society, for which the Council is nominally responsible, have in practice been left largely in the hands of the Officers. To encourage further activities, and at the same time to obtain a more equitable division of labour, it would be highly advantageous if the Council were to meet regularly. Appropriate committees appointed by Council would be in a position to take over responsibility for the *List of Common Names of British Plant Diseases*, or *List of Common British Plant Diseases* as it is to be called in the next edition, and also for the lists of British fungi. Further, it is much to be hoped that the pioneer work in preparing arguments for and against the acceptance of the many names proposed as *nomina generica conservanda*, begun by the Society's Nomenclature Committee in 1939, will be resumed at the first opportunity, and will be pressed to its logical conclusion at the next International Botanical Congress.

Activity need by no means stop there. Other possibilities will doubtless occur to all of you, but there is one relating to the training of plant pathologists that I should like to emphasize. Most post-graduate plant pathologists have a working knowledge of the classification of the pathogens they deal with, but very few, if any, understand the principles underlying the nomenclature of fungi. Too often the economic mycologist is left to discover for himself the significance of exsiccata and type material, the intricacies of the rules of botanical nomenclature, and the correct way of describing the fungi he investigates. The Society could and would confer a great service to plant pathology if it took the lead in an attempt to rectify this state of

affairs, for it must be admitted that such matters can be taught only by those who have already learnt.

When all is said and done, however, the fact remains that the reputation of the Society was built up on field work, and in the long run its future prosperity must depend largely on a return to the collecting tin. I would like to see a few young and enthusiastic collectors given the opportunities so freely granted by the Society to plant pathologists during the past decade or so. Set them to work for a time among the local Natural History Societies with a view to obtaining at least one recruit from each district; and then see that those recruits have all the encouragement they will need. They will at first no doubt regard themselves as very small frogs in a big pond, but their influence as big frogs in their own small local ponds would have an inestimable effect not only on the study of local fungus floras, but also on the vigour and further development of this Society.

In 1946 we celebrate our Jubilee. It was at Selby where the Society was founded in September 1896, Selby where it was reconstituted and strengthened in September 1918. I should like it to be said one distant day that it was Selby where, in September 1946, the Jubilee foray established yet another landmark in the history of the Society, because it signified the return to dominance of the collector and naturalist, whether professional or amateur.

BACTERIAL DISEASES OF STONE-FRUIT TREES IN BRITAIN

VIII. BACTERIAL CANKER OF PEACH

By H. WORMALD

(With Plate X)

During the course of the investigations on bacterial diseases of plum and cherry trees in Britain, attention has been directed to the possible appearance of similar diseases on other species of stone-fruit trees, and their occurrence on the almond (*Prunus Amygdalus*) and on the purple-leaved plum (*Prunus Pissardi*) has already been described (Wormald, 1938*a*). Bacterial Canker of peach was observed as long ago as 1927, but only on one tree, and it has not been noted again on peach trees in this country. In plum, cherry and almond, Bacterial Canker is associated with a leaf spot which has been shown to be the summer phase in the annual cycle of the diseases caused by the organisms *Pseudomonas prunicola* and *P. mors-prunorum*, and it is possible that a similar bacterial leaf spot occurs on peach trees in Britain, but if so it has not yet been recorded. Peach leaves in this country often show spots bearing a superficial resemblance to the bacterial spots of other host plants, but no bacteria have been found in these leaf spots of peach, the only organism commonly associated with them being a fungus, a species of *Hormodendron*. In America a peach leaf-spot disease of frequent occurrence is caused by *Bacterium Pruni*, but this organism has not been recorded in Britain. The cankered peach tree may have been infected with bacteria from leaf spots on that tree in 1926, but it is possible that infection came from bacterial spots on the leaves of neighbouring plum or cherry trees, for, as shown below, the organism on any one of these hosts can infect the other two. This account of Bacterial Canker in peach has been delayed in the expectation of finding the leaf-spot phase on peach, or of meeting with other examples of bacterial canker on this host, but no such disease has again come to my notice, and bacterial infection of the peach in Britain would seem to be rare. The observations recorded below show however that it is susceptible to bacterial canker, and the fact that it is a possible host of the canker organism is of some importance in considering control measures against this destructive disease of stone-fruit trees.

In May 1927, a young peach tree showing 'Die Back' was taken from a private garden at East Malling and examined. The variety was Hale's Early, grafted on Black Damas C. One side of the tree was almost dead (see Pl. X, fig. 1), and the cortex was brown along the whole length of this main branch. The discoloured cortex was found to contain numerous bacteria, so culture plates were prepared and an organism isolated, which, from the structure of its colonies and its habit in certain culture media, appeared to be identical with an organism frequently isolated from diseased plum and cherry trees about that time, and later named *Pseudomonas mors-prunorum* (Wormald, 1932).

In November 1927, inoculation experiments were carried out with the organism isolated from this peach tree.

Exp. 1. Inoculations were made on five young branches of a peach tree (var. Hale's Early) growing in a pot, five other branches serving as controls. The inoculations were made through small wounds, a drop of a suspension in water of the growth from a two-day-old agar culture being placed in each wound. The control branches were similarly cut but not inoculated.

When the tree was examined the following summer the control wounds had healed normally but at the inoculated wounds there were lesions 2–3 cm. long, four of them half girdling the branches while the other had completely girdled the branch and so caused the death of that part above the lesion.

Exp. 2. Inoculations were made on the main branches of young peach trees in nursery rows (var. Hale's Early on Arnold's Bush). Each tree was inoculated through Λ-shaped cuts at two places, one at about 1 ft. above the ground, the other higher up. The control trees were similarly wounded, but sterile water only applied to the cuts.

By the following summer lesions from 3 to 14 cm. long (mostly 6–10 cm.) had appeared at all the inoculated wounds and nine of the ten branches were girdled and dead above the lesions. Two of these are shown in Pl. X, figs. 2 and 3. No lesions developed on the control trees.

Exp. 3. This experiment was carried out to ascertain whether the organisms isolated from plum, cherry, and peach were able to infect all three hosts. Inoculations were made on comparable one-year-old branches on plum, cherry, and peach trees, and the results, as observed the following summer are shown in Table 1.

Table 1. *Results of inoculations with three strains of* Pseudomonas mors-prunorum

Strain isolated from	Length of lesions in cm. on Plum	Cherry	Peach
Plum	4–10·5	0–2	3–6
Cherry	1–4	5–6	3–5
Peach	1–1·5	1–1·5	2–4

It will be seen that in each series the cankers produced by any one strain are longest on the same species of host plant as that from which the isolation was obtained. These results seem to indicate some degree of specialization, but, as the inoculations were comparatively few (four on each host with each strain) and with only one strain from each host plant, the evidence cannot be assumed to be conclusive, particularly since in more recent experiments it was found that among strains from cherry some were more virulent than others (Wormald, 1938*b*). The results suggest also that this particular peach strain was less virulent than those from plum and cherry, for the cankers it produced were, on the whole, on whichever host, smaller than those resulting from inoculations with the other two strains.

The organism from the peach canker has been compared in culture media with various strains isolated from plum and cherry trees. As only one isolation of the peach organism has been possible its range of variation has not been determined, but in most of its reactions it has been found to conform to those of strains of *Pseudomonas mors-prunorum* isolated from plum and cherry. The chief characters common to the peach organism and other strains of *P. mors-prunorum*, distinguishing them from the related organism *P. prunicola* which has also been isolated from plum and cherry trees, are:

Nutrient broth + 5 % *saccharose*. White cloudy growth, no yellowish tint.

Nutrient agar + 5 % *saccharose*. Rapid production of acid; the growth is usually dead in from 4 to 6 days, probably as a result of this high degree of acidity.

Nutrient agar + 2 % *lactose, with bromo-cresol purple as indicator*. Reaction at first alkaline, later acid, so that the medium turns yellow.

Uschinsky's solution. White cloudy growth, no yellow tint.

The various strains of *Pseudomonas mors-prunorum* that have come under study vary among themselves in their reaction when grown in milk cultures. Typically they produce a solid curd which has an acid reaction (yellow in milk containing bromo-cresol purple), but with a little whey above the curd.

The peach strain in milk cultures gave the following reactions as noted at the end of six months:

Plain milk. Indistinguishable from control tubes in colour and consistency, except for a trace of precipitate.

Litmus milk. Trace of precipitate; colour rather deeper than in control tubes.

Milk with bromo-cresol purple as indicator. A very slight change in the acid direction, but not enough to produce curdling.

Methylene blue milk. Eventually greenish (Dark Bluish Glaucous of Ridgway).

The plain milk cultures showed so little change from the control (not inoculated) tubes that it might have seemed doubtful whether

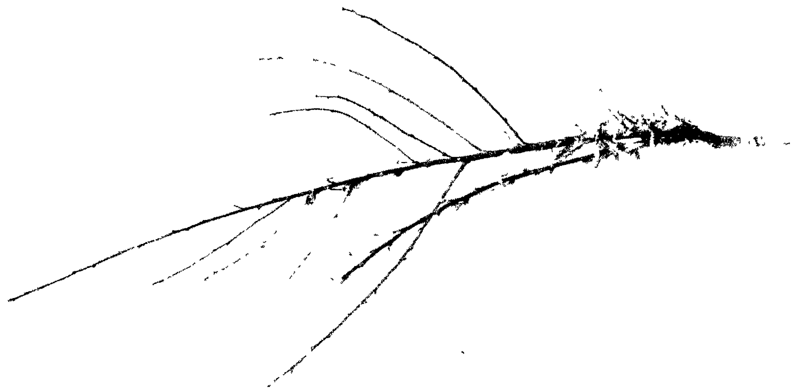

Fig. 3

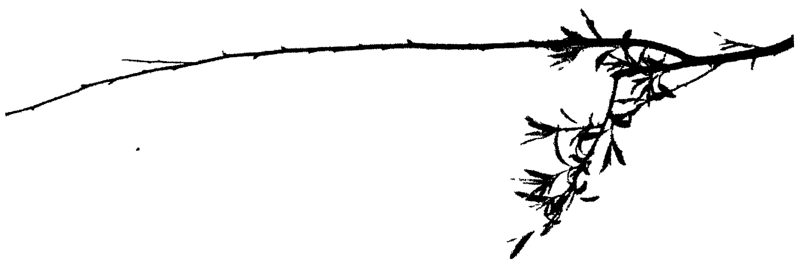

Fig. 2

Fig. 1

there was any noticeable growth at all in this medium, but the change of tint in milk containing any one of three indicators showed that definite growth must have occurred.

Since strains of *Pseudomonas mors-prunorum* from both plum and cherry show a range of reaction in milk cultures the characters shown in which the peach strain deviates from the type are not considered to have any specific significance.

SUMMARY

A bacterial canker of a peach tree is described. The organism isolated from the canker, when inoculated into peach, plum and cherry branches, produced typical bacterial cankers. The organism in its chief characters conforms to *Pseudomonas mors-prunorum* Worm. and is therefore referred to that species.

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EXPLANATION OF PLATE X

Fig. 1. Peach tree with a bacterial lesion (natural infection) on the branch on the right; on this branch the leaves are withering.

Figs. 2, 3. Two peach trees each of which had been inoculated on the branch on the right in November, and photographed the following May.

(*Accepted for publication* 30 *October* 1941)

NOTES ON ENTOMOGENOUS FUNGI

By T. PETCH

161. *EMPUSA ACARICIDA* Petch

THE red-legged earth mite (*Halotydeus destructor*), a serious pest of certain forage crops in Western Australia, was found by Mr K. R. Norris to be attacked by a fungus which he identified as an *Empusa*, and subsequently Mr Norris sent me specimens from which it was possible to confirm his identification. No *Empusa* has been recorded on mites before, and this is a new species. Mites attacked by this fungus may be picked out in the field because of their change of colour. Normally the mite has a black body and red legs, but when attacked by the *Empusa*, the whole of the dorsal surface and the sides of the body become yellowish brown, and this area is sharply demarcated from the black ventral surface. An account of the fungus, including a formal description under the name *Empusa acaricida*, has been published in Australia in *Proc. Linn. Soc. N.S.W.* LXV, 259–60, 16 September 1940.

The mites killed by this *Empusa* are attached to the host plant by their mouthparts or are entangled in the tomentum of the leaf. There are no rhizoids. The conidiophores are short, stout and unbranched. The primary conidia are oval, 9–12×5–$7\,\mu$, or subglobose, $8 \times 6\,\mu$, always with a broad, truncato-convex papilla. The secondary conidia are similar, and are borne on a stout germ tube from any part of the primary conidium, but usually laterally, as in *Entomophthora Aphidis*.

162. *CORDYCEPS MILITARIS* (L.) Link

Cordyceps militaris is a well-known parasite of lepidopterous larvae and pupae, to which hosts it is supposed to be confined, though there are records of its occurrence on Coleoptera, one by Roumeguère in *Revue Mycologique*, VI, 150 (1884), on a cockchafer, Dept. Aude, France, and another by Briard, in *Florule Cryptogamique de l'Aube*, p. 339 (1888), on the remains of a cockchafer buried in the soil in the wood of Bailly, Dept. Aube, France, while in Farlow and Seymour, *Provisional Host Index of the Fungi of the United States*, the entomogenous fungi of which were revised by Thaxter, *Lachnosterna quercina* is given as a host.

It has been surmised that either these records were erroneous, or that they really referred to *Isaria farinosa*, which was then believed to

be the conidial stage of *Cordyceps militaris*. It was a common practice at that time to record the perfect stage of a fungus, when only the imperfect stage had been collected, e.g. *Tubercularia vulgaris* would be recorded as *Nectria cinnabarina*. In 1939, however, I was able to examine a specimen which, up to a point, supports the records quoted.

The specimen was collected on 16 September 1938 at Gönnebeck, East Holstein, by Dr Meyer who was engaged on an investigation of the cockchafer pest, and was forwarded to me by Dr H. Blunck, Director of the Institute for Plant Diseases, Bonn. It was said to have occurred on a second year cockchafer larva, buried at a depth of about half a centimetre. I have not seen the larva, but in the circumstances there should be no doubt about the identification. The larva was covered, except for the head, with an irregular, dirty white mycelial layer, with rhizomorphic strands spreading through the soil. From the neck arose a group of four clavae, 15–20 mm. high and about 2 mm. diameter, sealing-wax red in colour when fresh. The lower part, or stalk, of the clava was almost smooth, while the upper third, or head, was rough with projecting ostiola. The clavae resembled exactly in appearance and structure rather stout clavae of *Cordyceps militaris*. Unfortunately they were quite immature, and I was unable to find asci. It is possible that the fungus may have ascospores different from those of *C. militaris*; and at present it cannot be decided whether *C. militaris* can attack Coleoptera, or whether there is another *Cordyceps*, indistinguishable from *C. militaris* on macroscopic characters, on those hosts.

163. *CORDYCEPS TYPHULAEFORMIS* Berk. & Cooke

This species was discussed in *Trans. Brit. Mycol. Soc.* XVIII, 49 (1933), where it was stated that although Cooke described the colour as red, there was no trace of red on the type specimen now, the colour being brownish yellow or dark amber and subtranslucent, and brownish yellow internally. I have since been able to examine further specimens of this species, and it appears to be certainly red when fresh.

Specimens on cocoons of nettle grub (Lepidoptera) from the Tea Experimental Station, Nilgiris, South India, were submitted to me in September 1934 by the Imperial Mycological Institute. The collector's note described it as orange-red, club-shaped. Numerous clavae arose from a single cocoon. The clavae were straight or curved, 1–2 cm. high, with a cylindrical or clavate, terete or more usually laterally flattened head, 4–10 mm. high, 1·5–2 mm. diameter, and a stalk 1·5–2 mm. diameter or broad. The stalk sometimes branched above, but only in one instance was a lateral branch fertile. The perithecia were usually lacking on a longitudinal band down one

side, but on the smaller specimens they were continuous; they appeared free, but evidently they were at first embedded in loose tissue up to two-thirds their height. The immature perithecia were flask-shaped, with a subcylindrical obtuse apex, up to 0·6 mm. high, 0·25 mm. diameter. The specimens had been preserved in formalin, and asci and spores could not be found.

Another specimen was included in a collection of entomogenous fungi from the Herbarium of the Missouri Botanic Garden, 'Clemens 7793 F, New Guinea, Morobe, Sambanga. Orange red fungus on caterpillar, November 26, 1937'. Fourteen clavae, up to 1 cm. high, grew from a hairy caterpillar. They were red and subtranslucent, with an ovoid or subglobose head, and strongly projecting free perithecia with yellow mycelium between them, sometimes lacking down one side of the head. The perithecia were conoid, obtuse, 0·6 mm. high, 0·5 mm. diameter. This specimen was mature, the asci being capitate, 4 μ diameter, and the part-spores rod-shaped, $4 \times 1\,\mu$.

I have also seen a specimen on a pupa from Behungi, Uganda, 4 April 1927, Linder no. 2526 in the Farlow Herbarium, in which the pupa bore two clavae only.

As the result of these examinations, the synonymy given in the previous note must be revised. *Cordyceps mitrata* Pat., *C. flavobrunnescens* P. Henn., and *C. coccinea* var. *subochracea* Penz. & Sacc., all from Java, are I think the same as *C. typhulaeformis*, but *C. deflectens* Penz. & Sacc. is most probably different.

164. *Isaria Cicadae* Miq. and *Cordyceps sobolifera* (Hill) Sacc.

In *Trans. Brit. Myc. Soc.* x, 39 (1924), *Isaria Sinclairii* (Berk.) Lloyd was redescribed from Ceylon specimens, with a photograph, and it was stated that it did not appear to differ from *I. arbuscula* Hariot from Mexico. That was followed in the same journal, xvi, 66 (1931), by a note on *I. Cicadae* Miq., the type of which came from Brazil, and later, in xviii, 64 (1933), after examination of specimens from Mexico in Herb. British Museum, the latter name was adopted for *I. Sinclairii* and a number of other species which had been recorded on cicadas. Most of the synonyms there given are cited for *I. Sinclairii* by Kobayasi in 'The genus *Cordyceps* and its allies' (*Science Reports Tokyo Bunrika Daigaku*, B. No. 84, v, 53–260, 1941), though he apparently dissents from its reference to *Isaria Cicadae* Miq. The same writer remarks (p. 245): 'Some authors think that this (*I. Sinclairii*) is the conidial stage of *Cordyceps sobolifera*, but against such a speculation we may mention the fact that the latter fungus is provided with the pycnidial lateral branches with conidia as already mentioned.'

In 1938, through the kindness of Professor C. W. Dodge, I was able

to examine a large number of specimens of *Cordyceps sobolifera* and *Isaria Cicadae* from the herbarium of the Missouri Botanic Garden, collected at San Sebastiad, Jalisco, Mexico (date not stated). Some isarial specimens had a large subglobose head, up to 1·5 cm. diameter, on a comparatively thin stalk, the individual branches of the head being more visible than is usual in fresh specimens of *I. Sinclairii*, though that may have been due to loss of conidia after collection. Others had clusters of branches arising directly from the insect, without a main stem. Clusters of conidial branches also arose from the stem of the perithecial clavae, or even from the head in immature specimens; and conclusive evidence of the relationship of *Cordyceps sobolifera* and *Isaria Cicadae* was provided by specimens in which the main stem divided into two or three stems, of which one terminated in the *Isaria* and the others in the *Cordyceps*.

In these specimens, the processes on the perithecial clavae were branches, often short and scattered, terminating in a conidial head, though in one instance the processes, arising just below the head, were long and branched, forming an isarial cluster which extended to half the height of the immature head. In a previous account I stated that these branches (soboles) were apparently easily detached; that was not so in the present specimens, in which the processes were stout branches, not separable without fracture. Some perithecial clavae showed no trace of soboles; others bore minute white points which might indicate where branches had been broken off, or more probably where they were beginning to develop.

The conidia in these specimens were cylindric with rounded ends, or very narrow oval, $7\text{–}11 \times 2{\cdot}5\text{–}3\,\mu$. The total height of the perithecial clavae was up to 8·5 cm., with a cylindrical head, rounded at the apex when mature, 2 cm. high, 3 mm. diameter, rough with slightly projecting ostiola when dry. The asci were $5\text{–}7\,\mu$ diameter, according to the degree of maturity of the spores, and the part-spores cylindrical, ends truncate, $7\text{–}12 \times 1\text{–}1{\cdot}5\,\mu$.

It is to be noted that Berkeley described the head of *C. sobolifera* as globose. In a West Indian specimen in Herb. British Museum, illustrated in *Trans. Brit. Myc. Soc.* XIX, 175, Fig. 2, the head is elongated oval. In a photograph of a specimen from the Bahamas, reproduced by Lloyd, *Mycol. Notes*, v, 584, the head is clavate. The latter specimen shows conidial processes on the stem, bearing, according to Lloyd, narrowly elliptical conidia, about $8 \times 4\,\mu$. It is evident that the shape of the head of *C. sobolifera* is variable, as indeed it frequently is in *Cordyceps*, e.g. *C. militaris*.

The specimens described above leave no room for doubt that *Isaria Cicadae* is the conidial stage of *Cordyceps sobolifera*. The latter species, however, has recently been redescribed by Kobayasi from Japanese specimens. His description agrees in the main with the Mexican

specimens as regards the perithecial stage, but he states, with figures, that the processes or soboles are pycnidial. Nothing resembling these pycnidia has been observed on the Mexican specimens. It may be that *C. sobolifera* produces both pycnidia and conidial synnemata on the perithecial clavae, but that is a matter for further enquiry. No *Isaria* stage has been reported for *Cordyceps sobolifera* from Japan, though *Isaria Cicadae* (*I. Sinclairii*) occurs in that country.

165. CORDYCEPS on mole crickets

In *Mycol. Notes*, VI, Fig. 1622, C. G. Lloyd published a photograph of an immature *Cordyceps* on a mole cricket under the name, *C. Gryllotalpae*; and on p. 913 he wrote: 'There are several specimens of this [at the New York Botanical Garden] on "ground puppies" or "sand moles", as Curtis calls them. They were sent to the Garden by E. C. Wurzlow, Houma, La. All are immature, but I have no doubt are young *Cordyceps*. Curtis lists the name but nothing further, and I did not find at Kew that he had sent any specimen to Berkeley.' The name does not appear to have been known to Cooke or Massee.

Lloyd's reference to Curtis is somewhat tantalizing, as he did not indicate where the list referred to was to be found or whether there was any specimen in the Curtis herbarium. As the name does not appear in any previous account of the genus *Cordyceps*, it would seem that it was a manuscript list. Moreover, there is no indication whether Curtis's specimen was a North American one or a Wright specimen from Cuba. The specimens at the New York Botanic Garden, of course, have no connexion with Curtis, and the assignment of his name to them rests on a series of assumptions which would only be justifiable if only one species of *Cordyceps* occurred on mole crickets. The photograph shows several (? nine) narrow clavae directed backwards more or less parallel to the insect, and suggests that the latter was upside down in its burrow, or that the clavae had been bent over in packing. Until more specimens have been collected in Louisiana, it is uncertain whether the mature clavae are linear or develop a head.

In his 'Genus *Cordyceps* and its allies' (1941) Kobayasi gives the name, *Cordyceps Gryllotalpae* Ellis & Seaver, for a Japanese *Cordyceps* on *Gryllotalpa*. His figure shows narrow cylindrical clavae, with an intercalary region bearing crowded, superficial perithecia. The ascospores are cylindrical, attenuated towards the ends, $40–63 \times 2–2{\cdot}5\,\mu$, 7–8-septate, not dividing into part-spores. His ascription of the name to Ellis and Seaver is probably due to Lloyd's statement on p. 912: 'We recently looked over the *Cordyceps* material at the New York Botanical Garden, where are preserved the specimens on which Ellis and Seaver, for the most part, based their work.' But Seaver did not mention *Cordyceps Gryllotalpae* in his *Hypocreales of North America*,

from which it may be deduced that the Louisiana specimens were not then in the herbarium.

Whether *Cordyceps Gryllotalpae* is to be attributed to Curtis or Lloyd must be left to experts in nomenclature. But the Japanese fungus is an *Ophiocordyceps*, and should stand as *Ophiocordyceps Gryllotalpae* (Kobayasi) Petch n.comb.

In *Trans. Brit. Myc. Soc.* XIX, 173 (1935) I recorded *Cordyceps amazonica* P. Henn. on a mole cricket from Trinidad, collected by Mr Stell in January 1925. In this specimen the clavae are fasciculate, two mature and one initial arising together from the insect, the height of the largest being about 2 cm. The stalk is pale brown, rough, terete, up to 2 mm. diameter below, 1·5 mm. above, and each mature clava has a short sterile branch a little distance below the head. The head is globose or ovoid, regular, sharply defined from the stalk, about 2·5 mm. diameter, red-brown, with dark brown, scarcely projecting ostiola. The head has a definite cortex, and the perithecia are immersed, perpendicular to the surface, narrow flask-shaped to elongated oval, 0·6 mm. high, 0·15 mm. diameter, crowded in a peripheral layer. The part-spores are cylindrical, ends rounded, $4 \cdot 5–6 \times 2–2 \cdot 5\,\mu$.

166. CORDYCEPS CITREA Penz. & Sacc.

This species was described by Penzig and Saccardo from a specimen collected at the hill station, Tjibodas, in Java on the larva of a beetle. I have a specimen, kindly sent to me by Dr W. McRae, collected at Shembagunur, Pulnis (6000 ft.), Madras Presidency, May 1922, on a larva which appears to be that of a beetle.

The larva is about 8 cm. long and 1 cm. diameter, and is enclosed for the greater part of its length in a smooth white coat of mycelium, which suggests that it was situated in a boring in wood. Towards the head, numerous branching strands of mycelium arise from the external coat, and some of these terminate in perithecial clavae. The largest clava arises from a flattened strand about 2 mm. broad, which expands into a flattened palmate clava, 1·2 cm. broad, dividing above into four conoid heads, up to 1 cm. long, the total height of the clava being about 2 cm. Another strand terminates in a clavate head, 1·5 cm. long, 4 mm. diameter, and another in a cylindrical head, 4 mm. long, 2 mm. diameter. The mycelium is white, but the heads are lemon-yellow, closely dotted with brown ostiola. The perithecia are immersed, but the head has no definite cortex, and the apices of the perithecia become prominent on the older parts. The apex of the head is rounded. The perithecia are oval, attenuated above, with a truncate apex, 0·55–0·7 mm. high, 0·25–0·28 mm. diameter, crowded; and the asci are cylindrical, capitate, with cylindrical, truncate part-spores, $4–8 \times 1\,\mu$.

Penzig and Saccardo described and figured a clava with an erect, compressed stalk, 4–4·5 cm. high, branching at the apex, with short, erect, cylindrical or compressed branches, terminating in elliptic, obtuse heads, 5–10 mm. long. In the present specimen the mycelium divides below ground and does not produce a single main stem. A more important difference is in the size of the perithecia, which Penzig and Saccardo stated were very small, 250 μ high, 90 μ diameter. Their specimen was apparently not quite mature, as they did not give the dimensions of the part-spores, but that would scarcely account for the smaller dimensions of the perithecia. It would seem possible that there may have been some error in measurement.

167. *Calonectria coccidophaga* Petch

This species was described with coloured figures and line drawings in *Trans. Brit. Myc. Soc.* VII, 141–3, Pl. IV, figs. 1–4 and Pl. V, figs. 7 and 13, together with its conidial stage, *Discofusarium tasmaniense* (McAlp.) Petch, syn. *Microcera tasmaniensis* McAlp. In 1935, Dr O. Reinking asked me to send him a specimen for examination, and I accordingly sent him the specimen figured on Pl. IV, fig. 3. In his reply Dr Reinking wrote: 'After having made a study and drawings of the ascospores as well as accompanying *Fusaria*, Dr Wollenweber came to the conclusion that the fungus was identical with *Gibberella pulicaris* (*Fusarium sambucinum*). The lighter coloured base of the perithecia turned bluish black upon addition of an alkali which would indicate that this colour modification is merely dependent upon the reaction.' This synonymy was published by Wollenweber & Reinking in their book, *Die Fusarien*.

The dried perithecia of *Calonectria coccidophaga*, when detached from the yellow stroma, appear black above, but pinkish yellow below. From the colour of the perithecium when soaked in water, it is probably very dark red when fresh. The wall is minutely pruinose, except round the ostiolum, probably from adhering rubbish, as it is otherwise smooth and has a horny appearance; it is rigid, not collapsing, and does not become wrinkled or warted in drying. Internally the wall is entirely rose-red, but in section the outer layers are vinous or purple-red, while the inner layers are yellowish white. It is composed of small cells, obscurely parenchymatous, with an external amorphous film. The cells round the ostiolum are thick-walled, oval, 4–5 × 3–4 μ, arranged concentrically. The wall is quite different from the coarsely parenchymatous, large-celled wall of *Gibberella pulicaris*. The ascospores are larger than those of the latter (22–34 × 8–9 μ), not the same shape, and distinctly thick-walled.

The *Fusarium* stage has a thick, white, marginal wall of parallel hyphae surrounding a disk of conidiophores, the latter salmon-pink

when fresh, but yellowish when dry. It looks like a *Peziza*. No doubt the presence of the marginal wall caused McAlpine to place the fungus in *Microcera*, but it is not similar to the sheath of *Microcera*. The conidia are three to five septate, $44-58 \times 5-6\mu$. Its only resemblance to *Fusarium sambucinum* is in its conidiophore, which is of the same type as that of the latter.

I did not trouble to contradict Wollenweber and Reinking's identification, being confident that no one who collected the fungus again in Australia would regard it as *Gibberella pulicaris*. It has, however, been pointed out to me recently, in connexion with my paper, *British Hypocreales*, that it is not sufficient merely to ignore erroneous records or determinations, and that if not contradicted they are regarded as correct and continue to be cited. (Incidentally, that was the reason for the publication of several sections of my recent paper, *Further Notes on British Hypocreales*.) Consequently I must express my complete disagreement with the statement that *Calonectria coccidophaga* is *Gibberella pulicaris*.

168. **Calonectria truncata** Petch, n.sp.

This species was collected by Mr R. G. Fennah in St Lucia, B.W.I., 20 November 1939, on a leaf-hopper, and was kindly submitted to me by the Imperial Mycological Institute. The insect is covered by a thin layer of white mycelium, in which the perithecia are partly immersed. The perithecia are pale yellow, broadly flask-shaped or conoid, 0·1 mm. diameter, 0·25 mm. high, tomentose at the apex with short, erect or spreading, rigid hairs, which make the apex appear truncate. The asci are clavate, $85-95 \times 14-15\mu$, the apex being truncate when immature, but not thickened, and becoming rounded or subacute when mature. The ascospores are fusoid, sometimes attenuated below, seven to fourteen septate, hyaline, $40-50 \times 7-9\mu$. This species differs from *Calonectria Hirsutellae* in the shape and colour of the perithecia, the shape of the asci and the dimensions of the ascospores.

The mycelium bears elongated conoid *Hirsutella* phialides, $14-18 \times 3-4\mu$, with a short sterigma. This is *H. floccosa* Speare. In describing *Calonectria Hirsutellae*, its conidial stage was said to be *H. floccosa*, but a re-examination of that specimen shows that the identification was incorrect; its phialides have a flask-shaped base, $9-18 \times 4-5\mu$, with a stout sterigma, 1μ thick, but complete sterigmata have not been observed and its identification is uncertain.

Calonectria truncata Petch, n.sp. Mycelio albo insectum obtegente; peritheciis in mycelio semi-immersis, pallide flavis, late ampullaceis vel conoideis, 0·1 mm. diam., 0·25 mm. alt., truncatis, apice crinibus brevibus rigidis rectis vel patentibus vestitis; ascis clavatis, octo-

sporis, 85–95 × 14–15 μ; ascosporis fusoideis, interdum infra attenuatis, hyalinis, 7–14-septatis, 40–50 × 7–9 μ. On leaf-hoppers, St Lucia, B.W.I.

169. *Torrubiella Blattae* Petch

This species, which occurred on the ootheca of a blattid, was collected by M. J. Vinson at Macabé, Mauritius, and was forwarded to me by M. Raymond Mamet.

The subiculum forms a somewhat definite, rather compact, white or cream-coloured patch, in which the perithecia are partly embedded. The perithecia are crowded, narrow flask-shaped or conoid, amber (when dry), darker at the apex, white tomentose below, glabrous above, 0·5 mm. high, 0·25 mm. diameter below. The wall is hyaline by transmitted light. The asci are long cylindrical, 3 μ diameter, and the ascospores linear, 0·75 μ diameter, multiseptate, with septa 4–6 μ apart. Part-spores were not observed.

A description of this species has been published in the *Mauritius Institute Bulletin*, II, 17 January 1941.

The type species of the genus *Torrubiella*, *T. aranicida* Boud., has no paraphyses. Those described by Boudier were immature asci, which have the usual capitate apex.

170. Pycnidia on Cicadae, etc.

When an entomogenous fungus attacks an adult insect, it may spread from the body to the wings and produce its fructifications on the latter. That occurs commonly in *Cordyceps tuberculata* (Lebert) Maire, *Hirsutella entomophila* Pat., and in most Entomophthoraceae. It is, however, rather surprising to find that the wings of certain insects are specifically mentioned as the habitat of several fungi. Spegazzini described *Phoma alicola* Speg. on the decaying wings of *Fidicina bonariensis* (Cicadae) in Argentina, Tassi described *Phoma Acridii* Tassi on the decaying wings of *Acridium peregrinum* in Italy, and Saccardo added *Phyllosticta Berlesiana* Sacc. on the wings of a dead *Cicada plebeja*, again in Italy. There is very little difference between the three descriptions. The pycnidia are described as lenticular or globoso-lenticular, and the structure of the pycnidium wall loosely parenchymatous, coarsely parenchymatous, and distinctly parenchymatous respectively, while the shape and dimensions of the pycnospores agree. *Phoma Acridii* was said to be near *Ph. alicola*. It would appear that all these three are the same species.

Septoria pterophila Sacc. was found on the decaying wings of *Cicada orni* in Italy, and *Vermicularia cicadina* Ell. & Kell. on the wings of a dead Cicada at Manhattan, North America. From the descriptions it would appear that these two are distinct species.

All these fungi were found on dead insects, and in three the wings were described as putrescent or putrid. It is probable, therefore, that they are not pathogenic, and it may be that they are merely common saprophytes on decaying animal matter.

171. **Hymenostilbe Aphidis** Petch, n.sp.

A *Hymenostilbe* on aphids was collected by Mr R. G. Fennah in Dominica, B.W.I., in January 1940, and was kindly forwarded to me by the Imperial Mycological Institute. The clavae are usually solitary, rufous brown, up to 2 mm. high, 0·1 mm. diameter, erect or suberect, straight or flexuose, equal or slightly thickened upwards, terete, minutely pruinose. They are clothed with a palisade layer of basidia, which are conoid, narrow flask-shaped, or subcylindrical, $12–18 \times 4–6\mu$, pale brown, with an abrupt, hyaline, stout, cylindrical sterigma, $3–6 \times 1\mu$. The conidia are narrow oval or fusoid, hyaline, smooth, $9–15 \times 4–5\mu$, with a short, truncate apiculus.

Hymenostilbe Aphidis Petch, n.sp. Clavis rufobrunneis, ad 2 mm. alt., 0·1 mm. diam., rectis vel flexuosis, aequalibus vel supra leniter incrassatis, teretibus, minute pruinosis; basidiis conoideis, vel anguste ampullaceis, vel subcylindraceis, pallide brunneis, $12–18 \times 4–6\mu$, sterigmate cylindraceo, hyalino, $3–6 \times 1\mu$; conidiis anguste ovalibus vel fusoideis, hyalinis, levibus, breviter apiculatis, $9–15 \times 4–5\mu$. On aphids, Dominica, B.W.I.

On the same specimen as the foregoing fungus is a *Hirsutella*, sometimes on the same aphis as a *Hymenostilbe* clava, sometimes alone on an aphis. The insects are overrun by hyphae, at first hyaline, becoming fuscous, varying in diameter from 2 to 6μ, which extend from them to the leaf. These hyphae bear *Hirsutella* phialides, hyaline, elongated conoid, sometimes attenuated regularly from the base, sometimes passing into a thin sterigma for one-half or one-third of their length, with a total length of $30–65\mu$, and a diameter of $4–5\mu$ at the base. They usually occur laterally on the hyphae, but are very variable. Sometimes a phialide forks equally, so that two appear to arise at the apex of a cylindrical base, $13–16 \times 5\mu$. Others may bear slender lateral sterigmata at varying heights. The mycelium and phialides form minute greyish tufts scattered over the insect, and in these it may simulate an irregularly branched conidiophore, up to 100μ high, with a main stem 6μ diameter at the base. The mycelium may also run over a *Hymenostilbe* clava and produce clusters of phialides on it. The spore cluster is oval, $10 \times 8\mu$, and the conidia are hyaline, cymbiform, $9 \times 1·5–2·5\mu$. This species is *Hirsutella Aphidis* Petch, *Naturalist*, 1936, p. 60, originally described from a specimen collected in England.

Several of the details of *Hymenostilbe Aphidis* suggest a comparison

with *Isaria acaricida* Pat. It appears possible that the latter may be a combination of the two species found in the present specimen, but that can only be decided by an examination of the type.

172. **Isaria (Beauveria) sphaerocephala** Petch, n.sp.

This species was collected at Peradeniya, Ceylon, in November 1912, on cocoons of *Thosea recta* Hmpsn. (Lepidoptera), one of the nettle grubs. The larva within the cocoon is covered with white mycelium, but only the clavae emerge. The latter when full grown have a stout simple stalk and a well-defined subglobose head. The stalk is up to 2·5 mm. high, 0·5 mm. diameter, expanding upwards, pruinose, cream-coloured or brownish, and the head is up to 2 mm. diameter, cream-coloured, farinose, appearing compact, but somewhat loose internally and composed of radial conidiophores. The conidiophores are 2·5 μ diameter, and bear lateral and terminal clusters of phialides, oval, 3–4 × 2 μ, or subglobose, 3 μ diameter, with conidia on thin, *Beauveria*-like sterigmata. The conidia are hyaline, oval, 2–2·5 × 1–1·5 μ, or globose, 1 μ diameter, not readily separating from the sterigma.

Isaria Orthopterorum Petch has a slender, zigzag or branching sterigma, not catenulate spores as stated in the original description, but differs from the present species in the size and shape of its conidia.

Isaria sphaerocephala Petch, n.sp. Clavis pistilliformibus, pallide flavidis; stipitibus ad 2·5 mm. alt., 0·5 mm. diam., supra incrassatis, pruinosis, brunnescentibus; capitibus ad 2 mm. diam., subglobosis, farinaceis, ex conidiophoris radiatim compositis; conidiophoris 2·5 μ diam., phialides in acervis lateralibus et terminalibus ferentibus; phialidibus ovalibus, 3–4 × 2 μ, vel subglobosis, 3 μ diam., in sterigmate tenui terminatis; conidiis lateralibus et terminalibus, hyalinis, ovalibus, 2–2·5 × 1–1·5 μ, vel globosis, 1 μ diam. On larvae of Lepidoptera, Ceylon.

173. *ISARIA TENUIPES* Peck

A redescription of this species, from American specimens, was published in *Trans. Brit. Myc. Soc.* XXI, 58 (1937). It occurs on lepidopterous pupae, and is similar in general appearance to *Spicaria* (*Isaria*) *farinosa*, but as a rule it is more feathery, and the arrangement of the phialides in spheres at the ends of simple hyphae makes the head more granular. The conidia are cylindrical or oblong-oval, 4–6 × 1·5–2 μ. I have recently received specimens of this from Mr E. A. Ellis, collected on two occasions, 15 October 1938 and 8 August 1940, at Wheatfen Broad, Norfolk. This is the first record of this species for Britain, though I have always been looking for some other

species among the scores of *Isaria farinosa* from all parts of England which I have examined during the last ten years. I find, however, that I have European examples of *I. tenuipes* from M. N. Taymans, Turnhout, Belgium, which I misidentified at the time as *I. dubia* Delacr. M. Taymans informed me that this long-spored *Isaria* was the common form in his district, and that he had not found *I. farinosa*. He had found *I. tenuipes* in 1939 at Westerloo, twenty miles from Turnhout, and at Schooten, six miles from Antwerp. The arrangement of the phialides in *I. tenuipes* is similar to that in *I. ochracea* Boud., but the latter has larger conidia.

174. *Spicaria prasina* (Maubl.) Saw.

A specimen of this species, on a caterpillar attached to a leaf of a grass, was found by Mr E. A. Ellis at Wheatfen Broad, Norfolk, in August 1939. As far as I am aware, this is the first European record of this fungus.

In *Trans. Brit. Myc. Soc.* XI, 264 (1926), I pointed out that, with certain additional punctuation, the description of *Botrytis Rileyi* Farlow might be taken as that of a *Spicaria*, and that the type should be compared with *Spicaria prasina*. The transfer has since been made by Miss V. K. Charles in *Mycologia*, XXVIII, 398 (1938), but I have not seen any statement that the essential comparison has been made.

175. *Spicaria gracilis* Petch

This species was described as *Coremium gracile* in *Trans. Brit. Myc. Soc.* XI, 260 (1926), and was transferred to *Spicaria* in *Notes on Entomogenous Fungi*, No. 45, *Trans. Brit. Myc. Soc.* XVI, 241 (1932). On further consideration, and a better knowledge of *Spicaria* (*Isaria*) *farinosa* as it occurs in Britain, I am of opinion that *S. gracilis* cannot be separated from the latter species. Like the latter it attacks insects of all kinds, but in general it does not occur in the isarioid form.

176. *Cephalosporium coccorum* Petch

This species was described as *Cephalosporium* (*Acrostalagmus*) *coccorum* in *Trans. Brit. Myc. Soc.* X, 171 (1925). Many of the species of *Cephalosporium* on insects produce *Acrostalagmus* conidiophores, often sparingly in nature but usually abundantly in culture. In the list of cultures issued by the Centraalbureau voor Schimmelcultures, Baarn, in 1936, this species is listed as *Verticillium coccorum*, and as reported in *Rev. App. Myc.* XVI, 677 (1937), P. Kotthoff in *Angew. Bot.* XIX, 127–30, stated that Miss Westerdijk had transferred it to *Verticillium* because of its profuse verticillate branching in old cultures. But that branching was recognized in the original naming, and the transference, if any were needed, should have been to *Acrostalagmus*.

177. *CEPHALOSPORIUM APHIDICOLA* Petch

Dr C. E. Foister sent me this species in February 1939, on the aphis, *Capitophorus fragariae*, on strawberry, presumably grown under cover, from Auchincruive, Scotland. It was originally described in *Trans. Brit. Myc. Soc.* XVI, 71 (1931), from Ceylon specimens. The conidia in the Scottish examples are oblong or oblong-oval, sometimes slightly curved, $4–8 \times 1·5\mu$, as against $5–9 \times 1·5–2\mu$ in the type. In *Trans. Brit. Myc. Soc.* X, 175 (1925), reference was made to *C. Lefroyi* Horne, described in *Gard. Chron.* LVII, 139 (1915), on *Aleyrodes vaporariorum* on *Centropogon*, a greenhouse plant, at Wisley. Its conidia were given as ellipsoid, ovoid, or oblong, straight or slightly curved, $\pm 7 \times 1–1·7\mu$. No specimens were preserved, and it has not been reported again. There would appear to be some probability that the two species are the same, notwithstanding the host difference, but the question must be left in abeyance until the re-discovery of specimens on *Aleyrodes*.

178. **Cephalosporium subclavatum** Petch, n.sp.

A diseased caradrinid larva (Lepidoptera), kindly forwarded by Mr J. C. F. Fryer, was found to be attacked by an undescribed species of *Cephalosporium*. When received, the larva was sparsely covered by loose greyish white mycelium bearing scattered lateral conidiophores, but on keeping it in a damp chamber it developed a dense white covering, tomentose with conidiophores, and ultimately in places a luxuriant fluffy growth. The conidiophores on the original sparse mycelium were lateral, simple, subulate, $12–18\mu$ high, $1·5\mu$ diameter at the base, tapering uniformly to the apex, with conidia $4–7 \times 1·5–1·75\mu$. In the more developed growth, *Acrostalagmus* conidiophores were produced, up to 400μ high, $2–3\mu$ diameter at the base, septate, with whorls of three to six branches in the upper part, the branches being 2μ diameter below, $20–25\mu$ long, subulate, tapering uniformly, with heads of conidia about 10μ diameter. The conidia were irregularly placed in the head, not parallel, and were oblong-oval or narrow-oval, the longer subclavate, ends obtuse, $4–8 \times 1·5–2\mu$.

Cephalosporium (*Acrostalagmus*) *subclavatum* Petch, n.sp. Mycelio albo insectum obducente; conidiophoris simplicibus, lateralibus, subulatis, $12–18\mu$ alt., basi $1·5\mu$ diam., vel ramosis, ad 400μ alt., basi $2–3\mu$ crass., supra verticillis 3–6 ramorum, $20–25\mu$ long., basi 2μ crass.; conidiis oblongo-ovalibus, angusto-ovalibus, vel subclavatis, obtusis, $4–8 \times 1·5–2\mu$. On larvae of lepidoptera, Britain.

179. *SOROSPORELLA* and *SYNGLIOCLADIUM*

Among a collection of diseased wireworms (*Agriotes* sp.) recently sent me by Mr H. C. Gough, Rothamsted, were several attacked by what I believe to be *Sorosporella uvella* (Krass.) Giard. The larvae were

completely filled with a solid, white or pale brown mass of cells, either globose, 9 μ diameter, or ovoid, 11–12 × 7–8 μ, hyaline, sometimes with short projecting remnants of adjacent cells, but otherwise smooth. This is *Sorosporella*. On keeping the specimens moist, they produced short clavae, sometimes in a continuous fringe along the sutures. These clavae bear short *Gliocladium* conidiophores, with subulate phialides about 18 μ long and 3 μ diameter at the base, each conidiophore bearing a globule of hyaline ellipsoid conidia, 5–7 × 3–3·5 μ. This is a *Synglíocladium*, and it is evidently the same as *Acremonium Cleoni* Wize, which was described from a juvenile condition and must now stand as *Synglíocladium Cleoni* (Wize) Petch. Both *Sorosporella uvella* (as *Tarichium*) and *Acremonium Cleoni* were originally described from specimens in and on the larvae of *Cleonus punctiventris*, a weevil which attacks sugar beet in Russia.

Tarichium uvella was described by Krassilstchik in 1886. Two years later, Sorokin described a similar fungus in lepidopterous larvae as *Sorosporella Agrotidis*. Giard noted the similarity of the two species, and united them under the name *Sorosporella uvella* (Krass.) Giard. But both names referred to a sclerotial or resting spore state, and now that another stage of each is known, it seems clear that the two fungi are different. Speare published a preliminary note on *Sorosporella uvella* in *J. Agric. Research*, VIII, no. 8, 189–94 (1917), and followed that with a fuller article in the same journal, XVIII, no. 8, 399–439 (1920), but his account deals with *Sorosporella Agrotidis*, not *S. uvella*. Speare was able to infect lepidopterous larvae with his fungus, but not coleopterous larvae. A full bibliography is given by Speare in his second paper.

Synglíocladium Cleoni has elongated conoid or subulate phialides about 18 μ long, 3 μ diameter below, and ellipsoid conidia, 5–7 × 3–3·5 μ. Speare's figure of the conidial stage of *Sorosporella Agrotidis* is of a *Synglíocladium*, though he did not show the conidia united in heads; he gave the conidia as 9–11 × 4–6 μ and the phialides as bottle-shaped or almost subulate. It should, however, be recorded that on a very young example of *S. Cleoni*, in which usually only one conidium was present on each phialide, the conidia were cylindrical or narrow-oval, with rounded ends, 6–13 × 1·5–3 μ.

Both in *Sorosporella uvella* and *S. Agrotidis* the internal cells are said to occur in loose masses, like bunches of grapes. In the English specimens, the internal cells form a continuous solid mass, white when fresh, pale brownish when dry. It is possible that the mass may disintegrate when old, but that condition has not yet been observed.

In *Trans. Brit. Myc. Soc.* XXIII, 133 (1939), I described, but did not name, a *Synglíocladium* on the larva of a beetle, *Phyllophaga anxia* Lec., which occurred at Apple Hill, Ontario, in a cell underground. On re-examining that specimen, it was found that the larva was com-

pletely filled by a hard, solid sclerotial mass, chocolate-brown when dry, rather pale brown when soaked, composed of globose smooth cells, 9–11 μ diameter, budding like *Sorosporella* cells, and stout irregular hyphae, all hyaline by transmitted light. This is a *Sorosporella*, and, as in *S. uvella* and *S. Agrotidis*, it has a *Syngliocladium* conidial stage. As previously recorded, the *Syngliocladium* produces clavae or strands of mycelium from all parts of the larva, lax, white, minutely pruinose, about 0·25 mm. diameter, terete or flattened, the branches and main stems of the clavae apparently extending indefinitely, but generally broken in this specimen and entangled with one another. The conidiophores are about 20 μ high, and variable in structure; some bear phialides on prophialides, while in others the prophialides are absent, and all combinations of the two conditions occur. The phialides are narrowly flask-shaped or conoid, attenuated above, 7–12 × 1·5 μ, and the prophialides oblong, up to 6 × 2 μ. The conidia are oval, oblong-oval, or oblong with rounded ends, 2–3·5 × 1 μ, with a few globose, 1·5 μ diameter. In the account cited, I associated this species with an immature *Cordyceps* found on the same insect. That was apparently a mistake, as there is no evidence of a *Sorosporella* in the larvae which bear the *Cordyceps*. I name the *Syngliocladium*, *Syng. intricatum.*

Syngliocladium intricatum Petch, n.sp. Cellulae internae (alias *Sorosporella*) globosae, hyalinae, leves, sclerotium durum fusco-brunneum formanites; synnemata circa 0·25 mm. diam., laxa, alba, ramosa, intricata; conidiophorae breves, circa 20 μ alt., prophialides (praesentibus) oblongae, ad 6 × 2 μ, phialides angustae ampullaceae vel conoideae, supra attenuatae, 7–12 × 1·5 μ; sporae ovales, vel oblongo-ovales, utrinque rotundatae, 2–3·5 × 1 μ, interdum globosae, 1·5 μ diam.

A re-examination of the type of *Syng. aranearum* Petch, the type species of the genus, did not reveal any *Sorosporella*. The body of the spider, however, was broken before it was collected, and it is possible that any sclerotial mass may have fallen out.

180. *Acremonium*

Wize described three species of *Acremonium* on the larvae and chrysalides of a weevil, *Cleonus punctiventris* in Russia, viz. *Acremonium Cleoni*, *A. Danyszii*, and *A. soropsis*, with figures. In dealing with fungi parasitic on insects it has to be borne in mind that most stilboid species, e.g. *Hirsutella*, *Gibellula*, *Tilachlidium*, etc., produce conidiophores and conidia on repent hyphae as well as on clavae, or prior to the formation of the latter. Consequently it is necessary to be certain that one has the full-grown fungus, not merely a juvenile form.

Acremonium Cleoni is evidently a juvenile form. The figure shows a single immature conidiophore growing from a cluster of *Sorosporella* cells. As already stated, the full-grown form is a *Syngliocladium*, which must stand as *Syngliocladium Cleoni* (Wize) Petch.

Acremonium Danyszii, from the figure, is evidently an early stage of a *Hirsutella*, probably *H. Eleutheratorum* (Nees) Petch, which is not uncommon on larvae of coleoptera.

Acremonium soropsis, represented and described as producing brown masses of cells on the exterior of the insect, is probably a *Synnematium*.

(*Accepted for publication* 7 *December* 1941)

LIST OF DISEASES OF ECONOMIC PLANTS RECORDED IN SCOTLAND

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(With 1 Text-figure)

A FIRST list of fungus diseases of economic plants received by the Plant Pathological Service for Scotland was published by Alcock and Foister in 1931 (**7**, xxx, 338). The present list incorporates the additional records which have accumulated during the succeeding decade, supplemented by reports by competent officers on the staffs of the Agricultural Colleges, whose assistance is hereby gratefully acknowledged. Our knowledge of the microfungi of Scotland is based largely on the enthusiastic pioneer work of a small body of collectors like Boyd, Keith and Trail. Their published lists have been drawn upon freely, though their usefulness is reduced by the frequent absence of any mention of the host plants concerned. The same applies to the records of the forays of the British Mycological Society in Scotland and those of the Cryptogamic Society of Scotland. A comprehensive account of the Scottish Rust Fungi by Wilson (**7**, xxxi, 345) is the source of many of the records of rusts of economic plants. Many of the records of heteroecious rusts contained therein are valueless for the present purpose, however, for they do not indicate which host was found to be diseased in a particular locality. The list of diseases of trees is drawn largely from papers in the *Transactions of the Royal Scottish Arboricultural Society* and the *Scottish Forestry Journal*. Strictly phytopathological papers are scarce, however, in Scottish literature, and it would appear that Scotland has never produced a notable plant pathologist.

The known distribution of the diseases is indicated in relation to the main drainage areas as laid down for *Insecta Scotica* (**1**, i, 161); these areas are indicated on the accompanying map. Diseases, the presence of which in Scotland has been verified by one of us, are indicated by an asterisk. The English system of a number of provincial mycologists reporting to a central laboratory has not been adopted in Scotland, with the result that information on the distribution of diseases is difficult to obtain. There seems to be a tendency to overlook the importance of diseases of the main agricultural crops, and most of the problems referred to the Plant Pathological Service relate

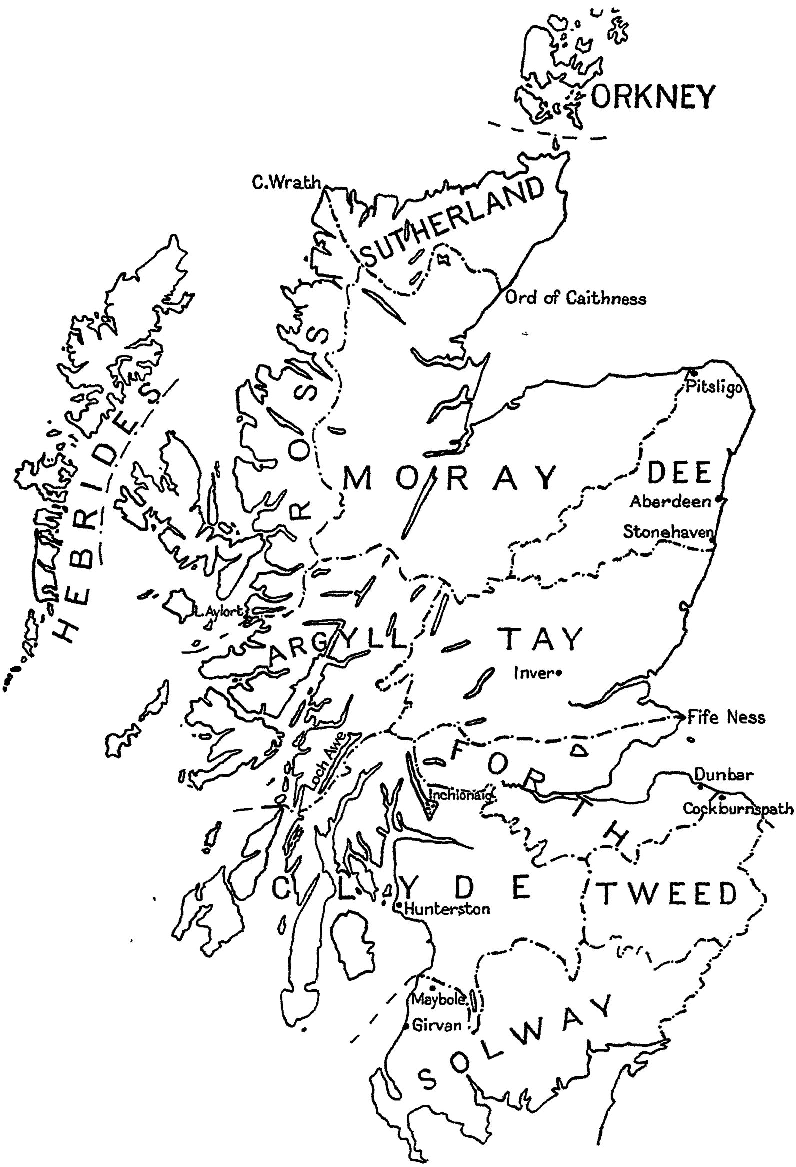

Fig. 1. Map showing the regions used in indicating the distribution of plant diseases in Scotland.

to horticultural crops, especially tomatoes and fruit. There can be little doubt that more could be done to prevent crop failures and losses if the interest of the agricultural community could be more extensively aroused in such practices, amongst others, as the routine disinfection of cereal seed and the dipping of potato tubers to prevent Dry Rot, Skin Spot and Blight. Indications of the losses caused by a few of the more important diseases of Scottish crops are given in a recent paper by Foister (**19**, xxiii, 168).

The distribution of the available records is as follows:

Solway	194	Dee	224	Sutherland	30
Tweed	164	Moray	251	Orkney	21
Forth	516	Argyll	78	Zetland	2
Clyde	475	Ross	56	Hebrides	3
Tay	341				

Even for the well-worked areas Forth and Clyde, the lists could doubtless be greatly extended, particularly in the sections dealing with forage crops and trees. As regards the other areas the above figures merely indicate the striking necessity for a fuller plant pathological service over the greater portion of the country. The distribution of a parasitic fungus is dependent on that of its host, at least in obligate parasites, and will accordingly fluctuate according as a given crop is more or less widely grown. Many of the more important fungi are seed-borne or are carried by the parts of plants used in vegetative propagation, and may therefore be expected to appear wherever their hosts are found, provided the environmental conditions are not too unfavourable to the growth of the parasite.

Comparison of the plant disease situation with that in England and Wales is difficult because the Ministry of Agriculture and Fisheries has not published a statement on crop diseases since 1932. Reference to the information available suggests that Scotland remains relatively free from a number of destructive plant diseases which are prevalent in England. Thus White Root Rot (*Rosellinia necatrix*) has not been reported, Violet Root Rot (*Helicobasidium purpureum*) is extremely rare, while rots due to *Sclerotinia sclerotiorum* are seldom encountered. All the downy mildews except *Peronospora parasitica* and *Phytophthora infestans* are also scarce.

On cereals, *Puccinia triticina*, *Ophiobolus graminis*, *Septoria Tritici*, *Dilophospora Alopecuri*, and *Rhynchosporium secalis* are either unknown or are seldom met with. Black Rot of Crucifers (*Pseudomonas campestris*) may occur in the field but seems never to have been authenticated. Plum Rust is scarce, while Sooty Blotch of Apple and Gnomonia Leaf Scorch of Cherry are not recorded. Strawberry diseases have been much studied in Scotland, but two fruit rots found in the south have not been met with, those due to *Septogloeum Fragariae* and *Phytophthora Cactorum*. Asparagus Rust (*Puccinia Asparagi*) has ap-

parently been extinct in Scotland since its discovery by Greville at Edinburgh in 1824.

Among diseases of ornamental plants so far unrecorded may be mentioned Brown Canker of Rose (*Diaporthe umbrina*) and Antirrhinum Shot Hole (*Heteropatella Antirrhini*).

While some of these diseases will probably be encountered in the future it appears probable that most of them do not occur here because environmental conditions are in some way unfavourable to them. Among the few diseases which have become established in the British Isles within recent years, some, like Elm Disease (*Ceratostomella Ulmi*), are well known to have failed to establish themselves north of the Border, whereas others have spread rapidly over the entire country. Thus Antirrhinum Rust, first recorded in England in 1933, was met with in Scotland in 1935 and has since been encountered in numerous localities, though it is too early to say if it is permanently established. Dahlia Leaf Spot, first collected in England in 1927, was recorded in Scotland in 1933 and is now common and widespread. On the other hand, *Puccinia mirabilissima* appears to have been first introduced from America into Scotland and to have spread thence to Wales, England and the European continent.

The lists include diseases caused by or associated with viruses, bacteria, fungi, eelworms and nutritional or physiological disturbances, listed in the above order. In practice, growers recognize as 'pests' pathogenic organisms large enough or active enough to be readily discernible by the unaided eye. Disorders due to all other agencies are classed as 'Diseases' and referred to the Plant Pathologist. Though fungi are associated with the majority of these troubles and are so recorded in this list, they are not always the primary cause of disease. Often, especially in disordered root systems, the primary cause of the disease is an environment unfavourable to the host. Remedial measures must then improve the environmental conditions, and attempts to control the disease by a direct attack on the fungus are unnecessary and useless. It follows, therefore, that the common description of plant pathology as 'Applied Mycology' is incorrect and misleading. This conception has hindered the progress of plant pathology by encouraging a complacent attitude on the part of the pathologist as soon as he has discovered an organism to be associated with a particular disease. It has had an even more disastrous effect on mycology by deflecting attention from the fungus as an end in itself, an object of beauty and a delight to the eye, and focusing it on the comparatively small number of fungi which are active parasites, plus a small group of facultative parasites associated with moribund tissues.

It follows that the fungus named in association with a particular disease cannot always be regarded with certainty as its primary cause.

Certainty can only be attained by reproduction of the disease under controlled conditions, using as inoculum pure cultures of the suspected organism. An Advisory Plant Pathologist has neither time nor facilities for such work. Fortunately for most important diseases there exists an experimental basis in the findings of research workers and institutes. There must always remain, however, many diseases of which the pathologist is able only to state his observations, leaving their interpretation open.

Our thanks are due more especially to Mr G. M. Stuart, Mr J. H. Moir, Mr D. S. Anderson, Prof. K. W. Braid and Prof. L. A. L. King, who have furnished us at regular intervals with reports on the diseases observed by them and their colleagues, and to the following authorities for the identifications indicated in the text: Dr K. M. Smith, Dr G. R. Bisby, Dr W. L. Gordon, Dr F. T. Bennett, Dr M. Wilson, Dr W. J. Dowson, Mr H. B. Bunting, Mr T. Petch, Miss E. M. Wakefield, Mr S. F. Ashby, and Dr G. H. Pethybridge. To the two last named we are particularly grateful also for ever-ready help and advice on innumerable problems, and especially in connexion with the identification of Phycomycetes. Finally, we are indebted to Mr W. C. Moore for criticizing the manuscript and for drawing our attention to a number of interesting records, including some from files inaccessible to us.

CEREALS

WHEAT

*Mildew	*Erysiphe graminis* DC.	Forth, Tay
*Take-all	*Ophiobolus graminis* Sacc.	Forth
*Ear Blight	*Gibberella Saubinetii* (Mont.) Sacc.	Forth (Det. F. T. Bennett)
Perithecia first recorded in 1939.		
Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)
*Bunt	*Tilletia caries* (DC.) Tul.	Tweed, Forth, Clyde, Tay, Dee
This disease has long been rare. Trail in 1891 (**1**, 3rd Ser. i, 33) could cite only a single record from personal experience; Boyd (**6**, N.S. iv, 25) had only one record in Ayrshire (1892) and cites only Greville's 1824 record for Forth (**9**, vii, 185). A specimen was received by us from Forth in 1938.		
*Smut	*Ustilago Tritici* (Pers.) Rostr.	Forth, Clyde, Tay, Dee, Moray
*Black Rust	*Puccinia graminis* Pers.	Tweed, Forth
Berberis vulgaris is a frequent hedge plant in these two areas.		
*Yellow Rust	*Puccinia glumarum* (Schm.) Erikss. & Henn.	Forth, Tay
Brown Rust	*Puccinia triticina* Erikss.	Tweed (Wilson, **7**, xxxi, 398)
A single record from Coldingham.		
*Glume Blotch	*Septoria nodorum* Berk.	Tweed, Forth, Clyde, Tay, Moray
*Ear Blight	*Fusarium culmorum* (W.G.Sm.) Sacc.	Forth
*Leaf Stripe	*Helminthosporium sativum* Pamm., King & Bakke	Clyde

WHEAT (*continued*)

*Black Mould	*Cladosporium herbarum* (Link) Fr.	Forth
*Black Point	*Alternaria* sp. (? *A. Peglioni* Curzi)	In samples of grain received at the Seed Testing Station
*Ear Cockle	*Anguillulina tritici* (Steinb.) Gerv. & v. Ben.	Forth, Tay

OATS

*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Leaf Stripe and Pre-emergence Blight	*Pyrenophora Avenae* Ito & Kuribay	Tweed, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland

Perfect stage recorded only from Clyde (Dennis, **3**, xix, 288).

*Whiteheads	*Ophiobolus graminis* Sacc. var. *Avenae* E. M. Turner	Tweed
*Loose Smut	*Ustilago Avenae* (Pers.) Jens.	Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland, Orkney

Said by Boyd (**9**, vii, 185) in 1914 to be very common in Forth, now almost unknown in the lowlands.

*Covered Smut	*Ustilago Kolleri* Wille	Moray
*Black Rust	*Puccinia graminis* Pers.	Solway, Tweed, Forth, Clyde
*Crown Rust	*Puccinia coronata* Corda	Forth, Clyde, Moray, Orkney

Particularly severe in 1933. As *Rhamnus* bushes are scarce in Scotland and there is evidence that the uredospores do not remain viable over winter, outbreaks probably originate from wind-blown spores from England or Ireland.

*Leaf Spot	*Septoria Avenae* Frank	Tweed, Clyde
Ear Blight	*Fusarium culmorum* (W.G.Sm.) Sacc.	Dee
*Pre-emergence Blight	*Fusarium* sp. (seed borne)	Moray
*Grey Speck	Manganese deficiency	Forth, Clyde, Tay, Dee

Usually induced by heavy, uneven application of lime to the soil.

*Tulip Root	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Tay, Moray, Orkney

BARLEY

*Mildew	*Erysiphe graminis* DC.	Tweed, Forth, Tay
*Whiteheads	*Ophiobolus graminis* Sacc.	Forth
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Dee, Moray
*Loose Smut	*Ustilago nuda* (Jens.) Rostr.	Forth, Tay, Dee, Moray
*Covered Smut	*Ustilago Hordei* (Pers.) Lagerh.	Moray. Plowright records '*U. segetum* var. *tecta*' on barley in Iona
*Rust	*Puccinia simplex* Erikss. & Henn.	Tweed, Forth
Yellow Rust	*Puccinia glumarum* (Schm.) Erikss. & Henn.	Tweed, Tay (W. G. Smith, **19**, v, 414)
*Net Blotch	*Helminthosporium teres* Sacc.	Tweed, Forth, Tay
*Leaf Stripe	*Helminthosporium gramineum* Rabenh.	Forth, Clyde

**Rhynchosporium Secalis* (Oud.) Davis, though not yet received on barley, has occurred on *Bromus* sp. in Forth.

RYE

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Argyll, Dee
*Black Rust	*Puccinia graminis* Pers.	Solway, Tay
*Rust	*Puccinia secalina* Grove	Forth, Tweed, Tay

ROOTS

POTATO

*Leaf Roll	Solanum Virus 14 K. M. Smith	The distribution of these potato viruses is discussed by Cockerham (**19**, xxii, 1)
*Mosaic	Solanum Virus 1 K. M. Smith	
	Solanum Virus 3 K. M. Smith	
*Severe Mosaic	Solanum Viruses 1 and 3	
*Leaf-drop Streak	Solanum Virus 2 K. M. Smith	

POTATO (*continued*)

*Top Necrosis (of King Edward and Kerr's Pink)	Probably Solanum Viruses 1 and 3 respectively Very seldom seen in the field	Forth, Tay
*Net Necrosis	Solanum Virus 14 K. M. Smith	

This is a tuber symptom associated with Leaf Roll in the first year of infection and in certain varieties only. Common in Golden Wonder, also recorded in Kerr's Pink.

*Blackleg	*Bacterium phytophthorum* (Appel) Stapp	Solway, Forth, Clyde, Tay, Moray, Ross, Sutherland, Argyll, Hebrides
*Common Scab	*Actinomyces scabies* (Thaxt.) Güss.	Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Hebrides
*Powdery Scab	*Spongospora subterranea* (Wallr.) Lagerh.	Tweed, Solway, Forth, Clyde, Tay, Moray, Ross, Sutherland
*Wart Disease	*Synchytrium endobioticum* (Schilb.) Perc.	Tweed, Solway, Forth, Clyde, Tay, Ross, Sutherland

Owing to the restriction in planting of wart-susceptible varieties, fresh outbreaks of this disease are rare. Since 1931 sixteen have occurred on holdings and 115 in private gardens or allotments. Details of the infected areas are given in an appendix to the Wart Disease of Potatoes (Scotland) Order of 1938.

*Watery Wound Rot	*Pythium ultimum* Trow	Forth, Clyde, Tay
*Blight	*Phytophthora infestans* (Mont.) de Bary	

Universally distributed in most years and still the main cause of losses in stored potato tubers. The cause of famine throughout the Hebrides and in the coastal districts from Ardnamurchan northwards in 1846.

*Pink Rot	*Phytophthora erythroseptica* Pethybr.	Forth, Clyde, Sutherland
*Stalk Break	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde, Tay, Dee
*Black Scurf and Stem Canker	*Corticium Solani* Bourd. & Galz.	Solway, Forth, Clyde, Tay, Moray, Ross, Argyll
Violet Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	Forth, Tay
Tuber Rot	*Armillaria mellea* (Vahl) Fr.	Forth (Wilson, **17**, xxxv, 186)
*Gangrene	*Phoma foveata* Foister	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Black Dot	*Colletotrichum atramentarium* (B. & Br.) Taubenh.	Forth, Moray

This fungus is common on decaying haulm at the end of the season and was noted by Keith (**1**, ii, 308) in 1873–4. It is of little importance in the field but causes rotting of sprouts under the moist conditions of the laboratory test for wart disease.

*Dry Rot	*Fusarium caeruleum* (Lib.) Sacc.	Solway, Forth, Clyde, Tay, Dee, Moray
*Dry Rot	*Fusarium culmorum* (W.G.Sm.) Sacc.	Fife
*Grey Mould	*Botrytis cinerea* Pers.	Solway, Forth, Clyde
*Verticillium Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth, Clyde
*Skin Spot	*Oospora pustulans* Owen & Wakef.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney

Also recently received on a tuber from the Faroe Islands.

*Silver Scurf	*Spondylocladium atrovirens* Harz	Forth, Clyde
*Potato Sickness	*Heterodera schachtii* Schmidt	

This pest is widely distributed in Scottish soils. Most of the records apparently relate to strains parasitic on clovers and grasses, but the potato race is well established in parts of Solway, Forth, Clyde and Tay.

*Stem Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Clyde, Tay
*Spraing	Cause unknown, common in Arran Pilot	Tweed, Forth, Clyde, Moray, Sutherland
*Internal Rust Spot	Cause unknown	Solway, Forth, Clyde, Moray

POTATO (*continued*)

*Superficial pitting of tubers	Probably due to storage under bad conditions; *Cylindrocarpon radicicolum* Wr. associated. (Det. G.R. Bisby)	Forth, Dee, Moray

Somewhat similar lesions are sometimes caused by contact with artificial manures.

*Black Heart	Non-parasitic	Forth
*Hollow Heart	Non-parasitic	Forth
*Glassiness	Non-parasitic	Forth, Clyde
*Jelly-end Rot	Non-parasitic, common in Arran Pilot	Forth, Clyde, Dee

The above three troubles are associated with second growth.

*Leaf Spotting	Manganese deficiency	Forth
*Leaf Spotting	Cause unknown, *Alternaria* sp. associated	Forth, Moray

TURNIP AND SWEDE .

*Mosaic	Brassica Virus 2 K. M. Smith	Forth
*Soft Rots	Various bacteria	Tweed, Solway, Forth, Clyde, Tay

A black pulpy bacterial rot commonly follows severe injury by larvae of the swede midge (*Contarinia nasturtii*). As a rule this does not penetrate beyond the neck and causes little loss, but it may occasionally assume alarming proportions, as in the Solway area in 1934. According to Lund the fluorescent bacterium associated with this type of rot in Denmark is *Bact. brassicaevorus* Delacroix. True Soft Rot of swede, in which the pulpy tissue is pale brown, seems to be associated mainly with injury to the root at or below soil level. From such tissue Dr Dowson has isolated organisms identified as *Bact. Aroideae* (Towns.) Stapp and *Pseudomonas medicaginis* var. *phaseolicola* (Burkh.) G. K. K. Link & Hull.

*Club Root	*Plasmodiophora Brassicae* Woron.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney, Shetland
*Hybridization Nodules	Attributed to *Olpidium radicicolum* De Wildem.	Forth, Clyde
*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Moray
White Blister	*Cystopus candidus* (Pers.) de Bary	Forth
*Mildew	*Erysiphe Polygoni* DC.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Rhizoctonia Rot	*Corticium Solani* Bourd. & Galz.	Forth

This fungus has also caused 'damping off' of swede seedlings under glass.

*Dry Rot	*Phoma lingam* (Tode) Desm.	Solway, Forth, Clyde, Tay, Dee, Moray
*Botrytis Rot	*Botrytis cinerea* Pers.	Forth

Destroys a small number of roots in pits. The rot differs in colour and texture from that caused by *Phoma lingam*, the rotten tissue is paler and more spongy and the lesion is usually delimited by a pinkish line.

*Leaf Spot	*Gloeosporium concentricum* (Grev.) B. & Br.	Forth
*Brown Heart	Boron deficiency	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross

**Alternaria Brassicae* (Berk.) Bolle and *A. circinans* (Berk. & Curt.) Bolle cause rotting of seedlings in germination tests, but neither has yet been observed to cause disease in the field.

SUGAR BEET AND MANGOLDS

*Mosaic	Beta Virus 2 K. M. Smith	Forth
*Crown Gall	*Bacterium tumefaciens* E. F. Sm. & Towns.	Tay
Heart and Dry Rot	*Phoma Betae* (Oud.) Frank associated, but the trouble is doubtless due to boron deficiency	Forth

FORAGE CROPS

WHITE CLOVER

Downy Mildew	*Peronospora Trifoliorum* de Bary	Solway (at Girvan, **4**, 1905), Clyde (Boyd, **6**, N.S. v, 162)
*Black Blotch	*Dothidella Trifolii* (Pers.) Bayl. Elliott & Stansf.	Solway, Tweed, Forth, Clyde, Tay

This fungus has been isolated from within Wild White Clover seed.

Rot	*Sclerotinia Trifoliorum* Erikss.	Dee

S. Trifoliorum* var. *minor* Alcock & Martin is frequently found in seed samples, but there is no evidence that it causes disease. There seems no reason to connect it with *S. Trifoliorum* Erikss., and Pape, **20, xxii, 187, regards it as a distinct species, as yet unnamed.

*Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	Solway, Forth, Clyde, Tay, Dee, Moray

Recorded on the ornamental form '*Trifolium purpureum*' at Girvan, Solway (**4**, 1905).

*Rust	*Uromyces flectens* Lagerh.	Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland
Rust	*Uromyces Trifolii-repentis* Liro	Solway, Tay, Clyde (Wilson, **7**, xxxi, 360)
Leaf Spot	*Stagonospora compta* (Sacc.) Died.	Clyde (Boyd, **5**, v, 123)

**Heterodera schachtii* Schmidt has been recorded on this host in Clyde.

RED CLOVER

Downy Mildew	*Peronospora Trifoliorum* de Bary	Clyde (Boyd, **5**, ii, 93), Dee (Trail, **1**, N.S. iii, 81)

Recorded on *Trifolium medium* by us in Solway, by Boyd in Forth (**9**, vii, 183) and Clyde (**6**, N.S. iv, 29) and in Dee by Trail; on *T. minus* by Boyd in Clyde and on *Medicago lupulina* in Tay (Trail, **1**, N.S. iii, 81).

*Mildew	*Erysiphe Polygoni* DC.	Forth, Clyde
Black Blotch	*Dothidella Trifolii* (Pers.) Bayl. Elliott & Stansf.	Moray (Keith, **1**, v, 9)

Also on *Trifolium medium* (Stevenson, **1**, N.S. i, 89) in Moray.

*Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	Forth, Clyde
Rust	*Uromyces Trifolii* Lév.	Moray (Wilson, **7**, xxxi, 360)
*Leaf Spot	? *Ascochyta Trifolii* Bond & Truss.	Tweed
*Scorch	*Kabatiella caulivora* (Kirchn.) Karak.	Forth, Clyde
Anther Blight	*Botrytis anthophila* Bond.	Clyde, fide J. H. Western

First reported, without locality, by Silow (**3**, xviii, 240).

ALSIKE CLOVER

*Mildew	*Peronospora Trifoliorum* de Bary	Forth
Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	

*Sclerotia of *Typhula Trifolii* Rostr. occur in seed samples of Polish and Canadian origin, received at the Seed Testing Station. The fungus has not been encountered in the field.

RYE-GRASS (*Lolium* spp.)

*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Blind Seed		Forth, Clyde, Dee

Caused by a Discomycete resembling *Stromatinia* (**21**, cxlvi, 492). The common saprophyte *Pullularia pullulans* (de Bary & Lw.) Berkh. is frequently associated with the parasite.

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Clyde, Dee
*Black Rust	*Puccinia graminis* Pers.	Clyde
*Rust	*Puccinia coronata* Corda	Forth, Clyde
*Leaf Spot	*Helminthosporium siccans* Drechsl.	Forth, Clyde

First collected in 1932, in Clyde.

MEADOW GRASSES (*Poa trivialis* and *P. pratensis*)

Mildew	*Erysiphe graminis* DC.	(Trail, **6**, N.S. iii, 13)
Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)

MEADOW GRASSES (*Poa trivialis* and *P. pratensis*) (*continued*)

Rust	*Uromyces Poae* Rabenh.	Dee (Trail, **1**, N.S. iv, 305)
*Rust	*Puccinia Poarum* Niels	Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Orkney
Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Dee (Trail, **1**, N.S. iii, 40)
*Leaf Spot	*Helminthosporium vagans* Drechsl.	Forth, Clyde

First collected in 1941.

? Root Galls	(of *Poa annua*) *Protomyces Rhizobius* Trail	Dee (Trail, **1**, N.S. i, 125)

TALL FESCUE (*Festuca elatior*)

*Mildew	*Erysiphe graminis* DC.	Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Tay, Dee
*Rust	*Puccinia Phlei-pratensis* Erikss. & Henn.	Clyde
Rust	*Puccinia coronata* Corda	(Wilson, **7**, xxxi, 396)

MEADOW FESCUE (*Festuca pratensis*)

Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)
Rust	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)

RED FESCUE (*Festuca rubra* var. *arenaria*)

Leaf Spot (*Festuca rubra*)	*Phyllachora graminis* (Pers.) Fuckel	Solway (**4**, 1924), Moray (**4**, 1938)

According to Sampson and Western (**15**, 16) the species on this host is *Phyllachora sylvatica* Sacc. & Speg.

Rust	*Puccinia Festucae* Plowr.	Argyll (Wilson, **7**, xxxi, 396)

SHEEP'S FESCUE (*Festuca ovina*)

*Choke	*Epichloe typhina* (Fr.) Tul.	Forth
Rust	*Puccinia Festucae* Plowr.	(Wilson, **7**, xxxi, 396)

Most published records of this rust are of *Aecidium Periclymeni* Schum.

Rust	*Uredo Festucae* DC.	Tweed, Solway, Forth, Clyde, Argyll, Moray, Ross (Wilson, **7**, xxxi, 441)
*Leaf Galls	*Anguillulina graminis* (Hardy) Goodey	Forth

A leaf smut resembling *Ustilago striaeformis* (Westend.) Niessl has occurred on *Festuca* sp. in fine turf. Trail (**1**, N.S. iv, 277 and 370) recorded *Urocystis Agropyri* (Preuss) Schroet. on *Festuca arenaria* in Dee.

WATER WHORL GRASS (*Glyceria aquatica*) and FLOTE GRASS (*G. fluitans*)

Ergot (*G. fluitans*)	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185), Moray (**4**, 1938)
*Smut (both species)	*Ustilago longissima* (Sow.) Tul.	Forth, Clyde, Tay, Dee, Moray, Ross
*Leaf Spot (*G. fluitans*)	*Scolecotrichum graminis* Fuckel	Forth, Clyde

TIMOTHY (*Phleum pratense*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Solway, Clyde, Dee
*Rust	*Puccinia Phlei-pratensis* Erikss. & Henn.	Clyde
*Leaf Spot	*Septoria oxyspora* Penz. & Sacc.	Tweed, Clyde, Dee

MEADOW FOXTAIL (*Alopecurus pratensis*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Dee

Also on *Alopecurus alpinus* var. *robustus* in Tweed (Fraser, **7**, xxviii, Proceedings, 12).

Rust	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)
Rust	*Puccinia perplexans* Plowr.	Dee (Trail, **1**, N.S. iv, 313)

A solitary record.

Leaf Spot	*Mastigosporium album* Riess	Dee (Trail, **1**, N.S. iii, 41)

COCKSFOOT (*Dactylis glomerata*)

*Slime Disease	*Bacterium Rathayi* (E.F.Sm.) Stapp	Tay
*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Forth, Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Solway, Clyde, Dee, Moray
*Choke	*Epichloe typhina* (Fr.) Tul.	Clyde, Tay
Smut	*Ustilago striaeformis* (Westend.) Niessl	Clyde (Boyd, **6**, N.S. iv, 25)
*Rust	*Uromyces Dactylidis* Otth	Tweed, Forth, Clyde, Tay
*Rust	*Puccinia coronata* Corda	Clyde
Black Rust	*Puccinia graminis* Pers.	Solway, Tay (**4**, 1924 and 1933)
*Leaf Spot	*Septoria oxyspora* Penz. & Sacc.	Clyde, Tay
*Leaf Spot	*Mastigosporium rubricosum* (Dearn. & Barth.) Sprague	Tweed, Forth, Moray

In the Clyde area close association has been observed between sporophores of *Psilocybe semilanceata* Fr. and isolated tussocks of cocksfoot planted out for seeding and surrounded by bare soil. The fungus was apparently living on the dead leaves at the base of the tussocks and caused no injury to the plants.

SWEET VERNAL GRASS (*Anthoxanthum odoratum*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Tay, Dee, Moray
Rust	*Puccinia Anthoxanthi* Fuckel	Solway, Dee (Wilson, **7**, xxxi, 401)
*Uredo Rust	*Uredo anthoxanthina* Bubák	Tweed, Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Ross, Sutherland

TALL OAT GRASS (*Arrhenatherum avenaceum*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Dee
*Smut	*Ustilago perennans* Rostr.	Tweed, Forth
Rusts	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)
	Puccinia coronata Corda	Forth (**4**, 1934)
	**Puccinia Arrhenatheri* Erikss.	Tweed, Solway, Forth, Clyde, Tay, Moray, Sutherland

BENTS (*Agrostis* spp.)

*Choke	*Epichloe typhina* (Fr.) Tul.	Forth, Tay
Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Dee (Trail, **1**, N.S. iv, 279)
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth
*Smut	*Tilletia decipiens* (Pers.) Körn.	Solway, Clyde, Argyll, Tay, Dee, Moray, Ross, Orkney, Shetland
Black Rust	*Puccinia graminis* Pers.	Solway (**4**, 1924)
Rust	*Puccinia coronata* Corda	Solway, Argyll, Orkney (Wilson, **7**, xxxi, 395)
Rust	*Puccinia Agrostidis* Plowr.	Solway, Tay, Dee, Moray (Wilson, **7**, xxxi, 403)
Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Moray (**4**, 1938)
*Leaf Spot	*Mastigosporium rubricosum* (Dearn. & Barth.) Sprague	Forth
Leaf Spot	*Hadrotrichum virescens* Sacc. & Roum.	Clyde (Boyd, **5**, viii, 55), Moray (**4**, 1938), ? Dee (Trail, **1**, N.S. iii, 4, as *H. microsporum* var. *majus* Trail)
*Leaf Galls	*Anguillulina graminophila* Goodey	Clyde, Dee

HOLCUS spp.

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Clyde, Dee
*Smut	*Ustilago striaeformis* (Westend.) Niessl	Forth, Clyde, Dee, Moray

HOLCUS spp. (*continued*)

*Smut	*Tilletia Holci* (Westend.) Schroet.	Forth, Moray
*Rust	*Puccinia holcina* Erikss.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney

Elliott (12, 3rd Ser. xi, 85) records *Puccinia coronata* Corda on *Holcus*, presumably in error as this host is not listed by Wilson (7, xxxi, 395).

*White Tip	*Sclerotium rhizoides* Auersw.	Forth
*Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Forth, Clyde, Dee, Moray
*Leaf Spot	*Ascochyta graminicola* Sacc.	Clyde
Leaf Spot	*Colletotrichum Holci* (Syd.) Grove	Clyde (3, vi, 369)

COUCH (*Agropyrum repens*)

Mildew	*Erysiphe graminis* DC.	Tweed, Forth, Clyde
Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Forth (4, 1934)
*Choke	*Epichloe typhina* (Fr.) Tul.	Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Dee
Smut	*Ustilago striaeformis* (Westend.) Niessl	Dee (Trail, 1, N.S. iii, 41)
*Smut	*Urocystis Agropyri* (Preuss) Schroet.	Forth
*Black Rust	*Puccinia graminis* Pers.	Tweed, Solway, Forth, Moray
*Rust	*Puccinia agropyrina* Erikss.	Tweed, Forth, Clyde, Tay, Dee
Rust	*Puccinia glumarum* Erikss. & Henn.	(Wilson, 7, xxxi, 398)
Leaf Spot	*Septoria affinis* Sacc.	Dee (Trail, 1, N.S. iii, 91)

HAIR GRASS (*Aira caespitosa*)

*Choke	*Epichloe typhina* (Fr.) Tul.	Tay
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Moray, Dee
Black Rust	*Puccinia graminis* Pers.	(Wilson, 7, xxxi, 394)
Rust	*Puccinia coronata* Corda	(Wilson, 7, xxxi, 396)
*Rust	*Uredo Airae* Lagerh.	Solway, Forth, Clyde, Tay, Ross
Leaf Spot	*Scolecotrichum graminis* Fuckel	Moray

CRESTED DOGSTAIL (*Cynosurus cristatus*)

*Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Clyde

QUAKING GRASS (*Briza media*)

*Black Rust	*Puccinia graminis* Pers. (Uredospores only). Det. M. Wilson	Tay

PURPLE MOOR GRASS (*Molinia caerulea*)

Choke	*Epichloe typhina* (Fr.) Tul.	Solway (Elliott, 12, 3rd Ser. xi, 84)
Rust	*Puccinia Brunellarum-Molinae* Cruchet	Clyde, Tay, Moray, Ross, Argyll (Wilson, 7, xxxi, 403)
Leaf Spot	*Septoria graminum* Desm. var. *Moliniae* Trail	Clyde (Trail, 1, N.S. iv, 66)

MARRAM (*Psamma arenaria*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee, Moray
Smut	*Ustilago hypodytes* (Schlecht.) Fr.	Dee (1, N.S. iv, 368), Moray (4, 1912)

Also on *Elymus arenarius* and *Agropyrum acutum* in Dee (4, 1931) and Tay (Trail, 1, N.S. ix, 368).

*Rust	*Uredo ammophilina* Kleb.	Solway, Forth, Clyde, Dee, Moray, Ross, Sutherland

Claviceps purpurea (Fr.) Tul. is also on record on *Nardus stricta*, *Digraphis arundinacea*, *Lolium temulentum* and *Aira flexuosa*. For other diseases see records under 'Turf' in section dealing with ornamental plants.

VEGETABLES

TOMATO

*Mosaic and Yellow Mosaic	Strains of Nicotiana Virus 1 K. M. Smith	Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland

A strain causing extreme distortion of foliage is not uncommon in Clyde.

*Streak	Lycopersicum Virus 1 K. M. Smith or Solanum Virus 1 K. M. Smith plus Nicotiana Virus 1 K. M. Smith	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray

Both forms of streak occur and it is not known which is the more prevalent.

*Spotted Wilt	Lycopersicum Virus 3 K. M. Smith	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Orkney

First recorded in 1932 and still too common, especially in small nurseries.

*Brown Rot	*Bacterium phytophthorum* (Appel) Stapp	Clyde, Tay (Det. J. W. Dowson)
*Crown Gall	*Bacterium tumefaciens* E. F. Sm. & Towns.	Clyde
*Fasciated Shoots	Possibly *Bacterium fascians* (Tilford) Lacey	Clyde
*Damping Off and Foot Rot	*Phytophthora cryptogea* Pethybr. & Laff. and *P. parasitica* Dast.	Solway, Forth, Clyde, Tay

These fungi frequently also cause root rot of large plants which is quite distinct from the disease referred to below as Toe Rot. The 'Toe Rot' of English authors appears to be of the former type.

*Toe Rot	*Phytophthora verrucosa* Alcock & Foister	Forth, Clyde, Tay, Dee

First recorded in 1934: great loss may be caused by this disease. Complete loss of crop in a succession of large glasshouses is recorded.

*Buck-Eye Rot	*Phytophthora parasitica* Dast.	Forth, Clyde
*Blight	*Phytophthora infestans* (Mont.) de Bary	Tweed, Solway, Forth, Tay
*Sclerotinia Disease	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde, Dee, Moray
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde, Tay
Violet Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	

Recorded in the previous list but has not been confirmed. Recent cultures from purple hyphal strands on tomato roots have yielded *Corticium Solani*.

*Root Rot	*Colletotrichum atramentarium* (Berk. & Br.) Taubenhaus	Forth, Clyde, Tay
*Brown Root Rot	Associated with *Cylindrocarpon radicicolum* Wollenw., *Thielaviopsis basicola* (Berk.) Ferraris, *Pythium* spp. and other fungi	Forth, Clyde

In this disease the roots of well-established plants die back from the tip, the cortex turns brown, decays, and is readily pulled away from the vascular cylinder. It is probably due primarily to some soil condition not yet understood, though lack of aeration resulting from formation of surface pans is almost certainly an important factor.

*Fruit Rot	*Phoma destructiva* Plowr.	Forth, Clyde
Fruit Rot	*Alternaria Solani* (Ell. & Mart.) Sor., emend. Jones & Grout	Forth
*Fruit and Stem Rot	*Botrytis cinerea* Pers.	Forth, Clyde, Tay, Dee, Moray, Argyll

Fruit spotting due to this fungus also occurs occasionally.

*Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth, Clyde, Dee, Moray
*Wilt	*Fusarium bulbigenum* Cooke & Massee var. *Lycopersici* (Brushi) Wollenw. (Det. W. L. Gordon)	Dee

(According to the classification of Snyder and Hansen this is *Fusarium oxysporum* Schl. f. *Lycopersici* (Sacc.) Snyder & Hansen.)

*Leaf Mould	*Cladosporium fulvum* Cooke	Solway, Forth, Clyde, Tay, Moray, Argyll, Ross, Sutherland

The first Scottish record of this dangerous parasite appears to be that by Boyd (5, i, 52) from Hunterston, Clyde, in 1908.

TOMATO (*continued*)

*Root Knot	*Heterodera marioni* (Cornu) Goodey	Tweed, Forth, Clyde, Dee, Moray
*Sickness	*Heterodera schachtii* Schmidt	Forth, Clyde, Moray

First recorded on tomatoes in 1939, now well established in Midlothian and Lanarkshire.

*Blossom End Rot	Non-parasitic	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray
*Blotchy ripening and Greenback	Potash deficiency	Forth, Clyde, Tay, Moray
*Oedema	Non-parasitic	Forth, Clyde, Argyll, Moray

Sunscald of fruit and leaves is an occasional source of enquiry, as is variegation due to ammonium poisoning resulting from an overdose of Cheshunt Compound or other disinfectant containing ammonia or ammonium salts. Not infrequently damage is caused to the foliage by an excess of lime in the soil.

CUCUMBER

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth
*Mildew	*Erysiphe Cichoracearum* DC.	Solway, Forth, Dee
Stem Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth
Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth
*Anthracnose	*Colletotrichum lagenarium* (Passer.) Ell. & Hals.	Forth, Clyde, Dee
*Grey Mould	*Botrytis cinerea* Pers.	Forth
*Oedema	Non-parasitic	Tweed, Solway, Forth

VEGETABLE MARROW

Mildew	*Erysiphe Cichoracearum* DC.	Dee
Anthracnose	*Colletotrichum lagenarium* (Passer.) Ell. & Hals.	Clyde, Dee
*Grey Mould	*Botrytis cinerea* Pers.	Forth, Ross

PEA

*Mosaic	Probably Pisum Virus 2 K. M. Smith	Forth
*Root Rot	*Aphanomyces euteiches* Drechsl.	Solway, Forth, Clyde, Tay, Dee, Moray

Pythium spp. are sometimes associated with Foot and Root Rots.

*Downy Mildew	*Peronospora Viciae* (Berk.) de Bary	Forth, Clyde, Tay

Also on *Vicia sepium* in Forth (Boyd, **9**, vii, 183), Clyde (**5**, ii, 92), Dee (Trail, **1**, N.S. iii, 80) and Orkney (Trail, **1**, N.S. iv, 31); on *V. Cracca* in Moray (Keith, **1**, N.S. i, 271), on *V. sativa* in Dee (Trail, **1**, N.S. iii, 80) and Clyde (Boyd, **6**, N.S. iv, 29) and on *Lathyrus macrorhizus* in Dee (Trail, **1**, N.S. iii, 41).

*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth, Clyde, Tay, Dee, Moray
*Foot Rot	*Mycosphaerella pinodes* (Berk. & Blox.) Vestergr.	Forth
*Foot Rot, Leaf and Pod Spot	*Ascochyta Pisi* Lib.	Solway, Forth, Clyde, Tay, Dee, Moray, Ross
*Foot Rot	*Fusarium Solani* Mart. var. *Martii* (App. & Wollenw.) Wollenw.	Forth
*Black Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Tay
*Leaf Mould	*Cladosporium herbarum* (Link) Fr.	Forth, Tay

Not a parasite but sometimes an object of inquiry.

Stripe; cause not investigated, probably due to one or more viruses		Forth, Tay, Moray
*Marsh Spot	Manganese deficiency	Clyde

This disease is common in pea seed of English origin received at the Seed Testing Station and seriously reduces the vitality of the seed.

*Eelworm	*Heterodera schachtii* Schmidt	Forth

DWARF AND RUNNER BEAN

*Mosaic	Probably Phaseolus Virus 1 K. M. Smith	Clyde
*Bacterial Blotch	*Bacterium Medicaginis* (Sacc.) E. F. Sm. var. *phaseolicola* (Burkh.) G. K. K. Link & Hull	Forth, Clyde, Tay (Det. J. W. Dowson)
*Root Rot	*Aphanomyces euteiches* Drechsl.	Forth

Apparently the only record; the fungus on this host was indistinguishable morphologically from that on pea.

*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde
*Anthracnose	*Colletotrichum Lindemuthianum* (Sacc. & Magn.) Bri. & Cav.	Solway, Clyde
*Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Forth
*Red Nose	*Macrosporium commune* Rabenh.	Found in a seed sample at the Seed Testing Station

BROAD BEAN

*Rust	*Uromyces Fabae* (Pers.) de Bary	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray

This rust is also recorded on *Vicia Cracca*, *V. sativa*, *V. sepium* and *Lathyrus pratensis* by Trail (**1**, N.S. iv, 303).

*Chocolate Spot	*Botrytis cinerea* Pers.	Solway, Forth, Clyde, Tay, Ross
*Leaf Spot	*Ascochyta Fabae* Speg.	Forth

Fructifying on seed at the Seed Testing Station; probably best regarded as a variety of *Ascochyta Pisi* Lib.

CABBAGE, CAULIFLOWER, ETC.

*Cabbage Ring Spot	Brassica Virus 1 K. M. Smith	Forth

First recorded in 1939.

*Cauliflower Mosaic	Brassica Virus 3 K. M. Smith	Forth

First recorded in 1940.

*Black Rot	*Pseudomonas campestris* (Pamm.) E.F.Sm.	Det. W. J. Dowson

Found on rape grown in trial plot at East Craigs from Argentine seed.

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Clyde
*Heart Rot	*Bacterium maculicola* McCulloch	Forth, Clyde
*Club Root	*Plasmodiophora Brassicae* Woron.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*White Blister	*Cystopus candidus* (Pers.) de Bary	Solway, Forth, Clyde, Tay, Moray

Races of this fungus are known in Scotland on *Barbarea vulgaris*, *Brassica arvensis*, *Capsella Bursa-pastoris*, *Cardamine flexuosa*, *C. hirsuta*, *Cochlearia officinalis*, *Sisymbrium officinale* (Trail, **1**, N.S. iii, 79), *Cardamine pratensis* and *Arabis alpina* (Boyd, **6**, N.S. iv, 28) in addition to the economic hosts cited on pp. 273, 282 and 287.

*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde, Tay

In addition to the hosts mentioned on pp. 273, 282, and 289 this fungus has been recorded in Scotland on *Brassica arvensis*, *Capsella Bursa-pastoris*, *Hesperis matronalis*, *Raphanus raphanistrum*, *Sisymbrium Alliaria* and *S. officinale* (Trail, **1**, N.S. iii, 81 and iv, 31).

*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth

Also on marrow-stem kale.

*Black Leaf-Spot	*Mycosphaerella brassicicola* (Fr.) Lindau	Forth, Solway, Moray
*Wire Stem	*Corticium Solani* Bourd. & Galz.	Forth, Clyde, Moray

Usually on seedlings in seedboxes or frames.

*Canker	*Phoma lingam* (Tode) Desm.	Forth
*Leaf Spot	*Gloeosporium concentricum* (Grev.) B. & Br.	Forth, Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Forth

Common on brussels sprouts in winter.

CABBAGE, CAULIFLOWER ETC. (*continued*)

*Oedema	Non-parasitic	Clyde
*Dwarfing	Cause unknown	Forth, Clyde

This disease was first encountered in 1940 in the variety Harbinger in Ayrshire. It is characterized by stunting of the plants as they approach maturity, accompanied by marked corrugation or 'quilting' of the lamina. The petioles of outer leaves bend upwards at almost a right angle near the base while the tips of the same leaves tend to curl downwards. There is no mottling of the leaves. Other varieties grown alongside remained normal. At the end of the year what seemed to be the same trouble was observed on cabbages which had begun to bolt on a Midlothian nursery. Numerous other varieties were found affected in 1941. A similar disease occurs on several hosts in Devon (**29**, xv, 4, 1938).

KOHL-RABI

Club Root	*Plasmodiophora Brassicae* Woron.	Solway

LETTUCE

*Mosaic	Lactuca Virus 1 K. M. Smith	Clyde
*Bacterial Spot	*Bacterium marginale* N. A. Brown	Forth, Clyde
*Downy Mildew	*Bremia Lactucae* Regel	Solway, Forth, Clyde

This fungus is rare on lettuce, but a morphologically identical form is common on native Compositae including *Sonchus asper* (Boyd, **6**, N.S. iv, 29), *Senecio sylvaticus* (Keith, **1**, N.S. i, 271), *S. vulgaris*, *S. Jacobaea*, *Taraxacum officinale*, *Sonchus oleraceus*, *S. arvensis*, *Cnicus lanceolatus* (Trail, **1**, N.S. iii, 80), *Cnicus arvensis*, *Hypochaeris radicata* and *Centaurea Scabiosa*. Cross-inoculations from the last named to lettuce gave negative results. Boyd (**5**, i, 52) has it also on the cultivated *Senecio elegans*.

*Seedling Root Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Ring Spot	*Marssonina Panattoniana* (Berl.) Magn.	Forth, Clyde, Tay, Argyll
*Grey Mould and Red Leg	*Botrytis cinerea* Pers.	Forth, Clyde, Argyll, Tay
*Tip-burn	Non-parasitic	Clyde

ONION

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth
*Downy Mildew	*Peronospora Schleideniana* W. G. Sm.	Forth, Clyde, Tay

First recorded by W. G. Smith in 1888.

*Smut	*Urocystis Cepulae* Frost	Tweed, Forth, Clyde

First recorded in 1912.

*White Rot	*Sclerotium cepivorum* Berk.	Tweed, Solway, Forth, Clyde
*Neck Rot	*Botrytis Allii* Munn	Forth, Clyde

LEEK

*White Tip	*Phytophthora Porri* Foister	Tweed, Forth, Clyde
*Smut	*Urocystis Cepulae* Frost	Tweed, Forth
*Rust	*Puccinia Porri* (Sow.) Wint.	Solway, Forth, Tay, Dee, Orkney

Also on *Allium Schoenoprasum* in Dee and Orkney (Trail, **1**, N.S. iv, 308), and on *A. vineale*. Another rust, *Caeoma Alliorum* Link, has been found once on leek in Clyde (Boyd, **6**, N.S. iii, Proceedings, 90).

*White Rot	*Sclerotium cepivorum* Berk.	Solway, Forth, Moray
*Pink Rot	*Fusarium* sp.	Forth

Conspicuous yellow striping of leek leaves, the cause of which is unknown, is occasionally reported from Forth.

SHALLOT

*Yellows	Cucumis Virus 1 K. M. Smith	Forth (Det. K. M. Smith)
*Downy Mildew	*Peronospora Schleideniana* W. G. Sm.	Tay
*Neck Rot	*Botrytis Allii* Munn	Solway, Moray

CELERY

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Solway, Forth, Clyde

CELERY (*continued*)

*Root Rot	*Pythium* sp.	Clyde
*Crown Rot	*Phoma apiicola* Kleb.	Solway
*Leaf Spot	*Septoria Apii* Chester	Solway, Forth, Clyde, Tay

Rust, *Puccinia Apii* Desm., has been recorded only once, in Tay (Trail, **1**, N.S. iv, 309), but the name 'Rust' is in common usage to describe brown markings on the petioles, such as result from slug or insect injury.

PARSLEY

Mildew	*Erysiphe Polygoni* DC.	Tay (**4**, 1933)
*Leaf Spot	*Septoria Petroselini* Desm.	Solway, Clyde, Tay, Dee, Moray

PARSNIP

*Mildew	*Erysiphe Polygoni* DC.	Forth

Observed on parsnip 'seed' at the Seed Testing Station.

*Canker. Primarily due to injury to roots by larvae of the carrot fly, *Cylindrocarpon radicicolum* Wollenw., associated	Solway

CARROT

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth

Recorded only in a consignment imported from Holland.

*Black Rot	*Alternaria radicina* Maier, Drechsler & Eddy	Forth

RED BEET

*Scab	*Actinomyces tumuli* Millard & Beeley	Solway, Forth, Clyde
*Leaf Spot	*Cercospora beticola* Sacc.	Forth
*Leaf Spot	*Phoma Betae* (Oud.) Frank, associated	Clyde
*Rust	*Uromyces Betae* Lév.	Dee, Moray

RHUBARB

*Crown Rot	Ascribed to *Bacterium rhaponticum* Millard	Forth, Clyde
Leaf Spot	*Ramularia Rhei* Allesch.	Moray (**3**, xxiii, 303)

HORSE RADISH

*White Blister	*Cystopus candidus* (Pers.) de Bary	Solway, Clyde, Forth, Dee
*Leaf Spot	*Ascochyta Armoraciae* Fuckel	Forth, Clyde
Leaf Spot	*Ramularia Armoraciae* Fuckel	Clyde (Boyd, **5**, v, 95)

MUSTARD AND CRESS

Damping Off	*Pythium de Baryanum* Hesse	Forth

MINT

*Rust	*Puccinia Menthae* Pers.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross

WATER CRESS

Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde (Boyd, **7**, vii, 183; **6**, v, 162), Dee (**1**, N.S. iv, 276)

SALSIFY

White Blister	*Cystopus cubicus* (Strauss) de Bary	Solway

MUSHROOM

*White Mould	*Mycogone perniciosa* Magn.	Forth, Clyde
	Verticillium Malthousei Ware	Forth (Ware, **22**, xlvii, 763, citing Malthouse, **9**, iv, 182, 1901)

JERUSALEM ARTICHOKE

*Stem Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth

FRUIT

APPLE

*Fruit Rot	*Phytophthora Syringae* Kleb.	Moray
*Mildew	*Podosphaera leucotricha* (Ell. & Everh.) Salm.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Canker	*Nectria galligena* Bres.	Solway, Forth, Clyde, Tay, Dee, Moray, Sutherland, Ross, Orkney
*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Forth, Tay
*Scab	*Venturia inaequalis* (Cooke) Wint.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland, Ross

Trail (**1**, N.S. ii, 229) has recorded the perfect stage in Dee and we have found immature perithecia in Forth.

*Blossom Wilt and Spur Canker	*Sclerotinia laxa* Aderh. & Ruhl. f. *Mali* (Worm.) Harrison	Solway, Forth, Tay
*Brown and Black Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Solway, Clyde, Tay, Moray, Ross
Silver Leaf	*Stereum purpureum* Pers.	?
*Blue Mould	*Penicillium expansum* Thom	Forth
*Eye Rot	*Botrytis cinerea* Pers.	Forth

On Cox's Orange Pippin purchased in Edinburgh but no doubt grown in England.

Fruit Rot	*Sphaeropsis Malorum* Berk.	Moray (Keith, **1**, iv, 346)
*Leaf Spot	*Phyllosticta* sp.	Clyde, Moray

Reported from Clyde in the previous list as *Phyllosticta solitaria* Ell. & Everh. Mr W. C. Moore, who has kindly examined the specimen from Moray, states that it is quite unlike *P. solitaria* and is evidently a secondary organism following Apple Scab. Boyd (in **4**, 1921) records *P. Briardi* Sacc. from Clyde; probably this refers to the same fungus.

*Leaf Scorch	Mainly potash deficiency	Clyde, Tay
*Glassiness	Non-parasitic	Forth

The following additional diseases have been encountered on imported apples:

*Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	1931–3

The imperfect stage *Gloeosporium fructigenum* Berk. was noted on apple at Perth by White (**1**, v, 277).

*Black Rot	*Physalospora obtusa* (Schw.) Cooke	1931–2

PEAR

*Leaf Blister	*Taphrina bullata* (Berk.) Tul.	Tweed, Clyde, Moray
*Canker	*Nectria galligena* Bres.	Solway, Forth, Clyde, Tay, Dee
*Scab	*Venturia pirina* Aderh.	Solway, Forth, Clyde, Tay, Moray
*Blossom Wilt	*Sclerotinia laxa* Aderh. & Ruhl.	Forth, Tay
*Brown Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Solway
*Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	Moray
Silver Leaf	*Stereum purpureum* Pers.	Tay
*Leaf Spot	*Septoria piricola* Desm.	Clyde
*Brown Heart	Non-parasitic	Forth
*Sleepiness	Non-parasitic	Tay, Moray

PLUM

*Bacterial Wilt and Canker	*Pseudomonas* sp., probably *P. mors-prunorum* Worm.	Forth, Clyde, Tay
*Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary var. *tridactyla* (Wallr.) Salm.	Moray

Also on *Prunus Padus* in Tay, Dee and Moray (Trail, **6**, N.S. iii, 11). *Uncinula prunastri* (DC.) Sacc. was recorded on '*Prunus*' by Boyd in Clyde (**5**, vii, 13) and on *P. spinosa* by Trail in Tay and Moray (**6**, N.S. iii, 15).

PLUM (*continued*)

*Pocket Plums	*Taphrina Pruni* (Fuckel) Tul.	Solway, Forth, Dee, Moray
Also on *Prunus Padus* in Clyde (5, v, 130), Tay (White, 1, v, 365), and Moray (13, 342), and on *P. spinosa* in Tweed (Hardy, 11, x, 214) and Tay (White, 1, v, 365).		
*Blossom Wilt, Wither Tip and Brown Rot	*Sclerotinia laxa* Aderh. & Ruhl.	Solway, Forth, Clyde, Tay, Moray, Ross
Also causing Wither Tip of wild *P. Padus* in Clyde.		
*Rust	*Puccinia Pruni-spinosae* Pers.	Forth, Tay, Moray
*Silver Leaf	*Stereum purpureum* Pers.	Forth, Clyde, Tay, Moray, Ross
Fomes Rot	*Fomes pomaceus* (Pers.) Lloyd	Clyde
*Die Back	*Cytospora leucostoma* (Pers.) Sacc., associated	Forth, Tay
Scab	*Cladosporium carpophilum* Thum.	Tweed, Clyde
*Shot Hole	*Cercospora circumscissa* Sacc.	Dee
*Shot Hole	*Phyllosticta* sp.	Forth
Leaf Spot	*Cylindrosporium Padi* Karst.	Tay (7, xxvi, Proceedings, 21)
Gummosis	Associated with an excessive supply of nitrogen	Tay

CHERRY

Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary	Moray (4, 1927)
Witches' Broom	*Taphrina Cerasi* (Fuckel) Sadeb.	Clyde
Recorded on gean (*Prunus avium*) in Solway, 1939.		
*Leaf Curl	*Taphrina minor* Sadeb.	Clyde
*Brown Rot and Blossom Wilt	*Sclerotinia laxa* Aderh. & Ruhl.	Tweed, Forth, Clyde, Tay
Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	Clyde

PEACH

*Bacterial Wilt	Perhaps *Pseudomonas mors-prunorum* Worm.	Solway
*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév. var. *Persicae* Woronich.	Solway, Forth, Clyde, Tay, Sutherland
*Leaf Curl	*Taphrina deformans* (Berk.) Tul.	Tweed, Solway, Forth, Tay, Moray
Also reported on *Prunus Avium* from Dee (Trail, 1, N.S. iii, 42). See also Almond (p. 296).		
*Brown Rot	*Sclerotinia laxa* Aderh. & Ruhl.	Forth
*Brown Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Dee
*Silver Leaf	*Stereum purpureum* Pers.	Moray
*Shot Hole	*Clasterosporium carpophilum* (Lév.) Aderh.	Clyde, Tay
*Scab	*Cladosporium carpophilum* Thüm.	Clyde, Dee

NECTARINE

*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév. var. *Persicae* Woronich.	Tweed
*Silver Leaf	*Stereum purpureum* Pers.	Forth
*Gummosis	Non-parasitic	Tay

APRICOT

*Canker	*Nectria cinnabarina* (Tode) Fr., associated	Forth

GOOSEBERRY

*American Mildew	*Sphaerotheca mors-uvae* (Schw.) Berk.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland
Occurs on wild gooseberries in the hedges.		

GOOSEBERRY (*continued*)

*European Mildew	*Microsphaera Grossulariae* (Wallr.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Forth, Moray
*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Clyde
Leaf Spot	*Pseudopeziza Ribis* Kleb.	? Solway
*Rust	*Puccinia Pringsheimiana* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland
*Die Back	*Botrytis cinerea* Pers.	Tweed, Forth, Clyde, Tay, Moray, Ross

**Rhizoctonia* sp. (probably *Corticium Solani* Bourd. & Galz.) is sometimes associated with a similar condition. *Hendersonia Grossulariae* Oudem., recorded from Forth and Clyde in the previous list, is probably not a parasite. *Phomopsis pungens* Grove and one or more species of *Phoma* commonly occur on gooseberry shoots injured by other organisms including aphides.

*Leaf Spot	*Phyllosticta Grossulariae* Sacc.	Forth, Clyde
Leaf Spot	*Ascochyta ribesia* Sacc. & Fautr.	Clyde (Boyd, in **4**, 1921)

BLACK CURRANT

*Reversion	Ribes Virus 1 K. M. Smith	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*American Mildew	*Sphaerotheca mors-uvae* (Schw.) Berk.	Tay, Moray
Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Forth, Dee
*Leaf Spot	*Pseudopeziza Ribis* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee
*Leaf Spot	*Mycosphaerella Ribis* (Fuckel) Kleb.	Clyde, Tay, Dee, Moray, Ross
*Rust	*Cronartium ribicola* Fisch. de Waldh.	Solway, Tay, Moray

Recorded from Tay in 1910.

Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde
*Die Back	*Botrytis cinerea* Pers.	Solway, Forth, Clyde, Tay

RED CURRANT

*Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Clyde
*Coral Spot and Die Back	*Nectria cinnabarina* (Tode) Fr.	Forth, Clyde, Dee
*Leaf Spot	*Pseudopeziza Ribis* Kleb.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross
Cluster Cup Rust	*Puccinia Pringsheimiana* Kleb.	Clyde
Rust	*Cronartium ribicola* Fisch. de Waldh.	Tweed, Clyde, Tay

A third rust, *Puccinia Ribis* DC., is known only from Keith's record, Moray, 1894 (**6**, N.S. iv, 287).

Die Back	*Botrytis cinerea* Pers.	Clyde

RASPBERRY

*Mosaic	Unidentified viruses	Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*Crown Gall	*Bacterium tumefaciens* E. F. Sm.	Tay
*Root Rot and Die Back	*Phytophthora Cactorum* (Leb. & Cohn) Schroet. var. *applanata* Chester	Forth, Clyde, Tay
Mildew	*Sphaerotheca Humuli* (DC.) Burr.	

This is probably the fungus referred to by Trail (**6**, N.S. iii, 15) as ? *Erysiphe Rubi* in Dee.

*Cane Spot	*Elsinoe veneta* (Burkh.) Jenk.	Forth, Clyde, Tay, Moray
*Spur Blight	*Didymella applanata* (Niessl) Sacc.	Forth, Clyde, Tay, Dee, Moray

First recorded in 1931.

*Cane Blight	*Leptosphaeria Coniothyrium* (Fuckel) Sacc.	Clyde, Tay
*Crown Rot	*Nectria mammoidea* Phill. & Plowr. var. *Rubi* (Osterw.) Weese	Forth, Clyde, Tay, Dee, Moray

RASPBERRY (*continued*)

*Rust	*Phragmidium Rubi-Idaei* (Pers.) Karst.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth

Rhizomorphs spreading from an infected stake attacked adjacent plants.

Leaf Spot	*Septoria Rubi* Westend.	Dee (Trail, **1**, N.S. iv, 281)
*Blue Stripe	*Verticillium Dahliae* Kleb.	Tweed, Forth, Clyde, Tay
*Die Back	*Fusarium* spp. associated	Forth, Clyde, Tay

This trouble is found in relatively exposed or high-lying plantations. At least one strain of *Fusarium avenaceum* (Fr.) Sacc. (Det. W. L. Gordon) has been isolated from dead shoots and shown to be able to kill raspberry buds. Usually, however, *Didymella applanata* is probably the primary parasite.

*Discoloration of Bark	*Botrytis cinerea* Pers.	Forth, Clyde
*Root Nodules	Cause unknown (see Wormald, **27**, 195)	Forth

STRAWBERRY

*Yellow Edge *Crinkle	Fragaria Virus 1 K. M. Smith Fragaria Virus 2 K. M. Smith	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland, Orkney

These two viruses are commonly found together and cause the most serious diseases of the strawberry.

*Fasciation	Perhaps *Bacterium fascians* (Tilford) Lacey	Clyde
*Red Core Root Rot	*Phytophthora Fragariae* Hickman	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Sutherland
*Mildew	*Sphaerotheca Humuli* (DC.) Burr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Leaf Spot	*Mycosphaerella Fragariae* (Tul.) Lind.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll

Most records refer to *Ramularia Tulasnei* Sacc. but the perfect stage is known from Aberdeen (Trail, **1**, N.S. iii, 173).

*Leaf Spot or Scorch	*Marssonina Fragariae* (Sacc.) Kleb.	Tweed, Solway, Forth, Clyde, Tay
*Black Root Rot associated with the following fungi:		
	Cylindrocarpon radicicolum Wollenw.	Forth, Clyde, Tay
	Leptosphaeria Coniothyrium (Fuckel) Sacc.	Clyde
	Pezizella Lythri (Desm.) Shear & Dodge	Clyde

Primarily due to bad soil conditions, especially those which result from inadequate drainage. O'Brien and McNaughton (**23**, i) have suggested that under soil conditions unfavourable to the crop the strawberry mycorrhizal fungus may become parasitic.

Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth
*Fruit Rot	*Corticium Solani* Bourd. & Galz.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth, Tay, Moray
*Red Plant	*Aphelenchoides fragariae* (Ritzema Bos) Goodey	Tweed, Solway, Forth, Clyde, Tay, Dee

Observed by Trail in Dee in 1891 (**2**, 1892, 79).

*Cauliflower Disease	*Aphelenchoides fragariae* (Ritzema Bos) Goodey	Forth, Clyde

This organism has been accepted as the cause but *Bacterium fascians* (Tilford) Lacey has been found to produce similar host reactions (see Lacey **24**, xxiii, 302).

*June Yellows	Non-parasitic	Forth, Clyde

GRAPE VINE

*Mildew	*Uncinula necator* (Schw.) Burr.	Tay
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Clyde
Leaf Spot	*Cercospora Roesleri* (Catt.) Sacc.	Tay (**25**, xv, 441, as *Cladosporium Roesleri* Catt.)

GRAPE VINE (*continued*)

*Shanking	Non-parasitic	Forth
*Intumescences	Non-parasitic	Clyde
*Scald	Non-parasitic	Clyde

WALNUT

Leaf Blotch	*Gnomonia leptostyla* (Fr.) Ces. & de Not.	Solway (Girvan, **4**, 1905), Tay (Trail, **1**, N.S. iii, 270)
*Fruit Rot	*Botrytis cinerea* Pers.	Moray

MELON

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Clyde
*Damping Off	*Phytophthora parasitica* Dast.	Tay

The following foreign fungi have been received on imported fruit:

**Diplodia natalensis* Pole-Evans, affecting 95% of a consignment of oranges from Jamaica.

**Penicillium digitatum* Sacc. and *P. italicum* Wehmer, on oranges.

**Aspergillus Tamarii* Kita and *Cephalosporium Bertholletianum* Spencer on Brazil nut.

**Macrophomina Phaseoli* (Maubl.) Ashby, on pea-nut.

ORNAMENTAL PLANTS

ABUTILON sp.

*Mosaic	Abutilon virus 1	Forth

AGAVE sp.

*Leaf Spot	*Coniothyrium concentricum* (Desm.) Sacc. var. *Agaves* Sacc.	Clyde

ALTHAEA ROSEA (Hollyhock)

*Rust	*Puccinia Malvacearum* Mont.	Tweed, Forth, Clyde, Tay, Dee, Moray, Ross

Trail (**1**, N.S. iv, 367) gives the first Scottish record as Montrose (Tay) July 1890, but there is a record on Hollyhock by Keith from Forres in **1**, N.S. i, 270.

ANEMONE CORONARIA

*Black Rot	*Sclerotinia tuberosa* (Hedw.) Fuckel	Tay
*Rust	*Puccinia Pruni-spinosae* Pers.	Forth, Clyde, Dee

ANEMONE JAPONICA

*Yellow Ringspot	Cause unknown	Forth

ANTIRRHINUM MAJUS

*Foot Rot	*Phytophthora* sp. and *Pythium* sp.	Dee
*Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Solway
*Rust	*Puccinia Antirrhini* Diet. & Holw.	Tweed, Forth, Clyde, Tay

First recorded in 1935; only slight local outbreaks have occurred.

*Collar Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Leaf Spot	*Diplodina Passerinii* Allesch.	Forth, Clyde
*Leaf Spot and Stem Rot	*Phyllosticta Antirrhini* Syd.	Solway, Forth
*Wilt	*Verticillium* sp.	Tweed, Clyde
*Stem Rot	*Fusarium* sp.	Clyde

AQUILEGIA VULGARIS

Rust	*Puccinia Agrostidis* Plowr.	Dee (Trail, **2**, ii, 188)
Leaf Spot	*Actinonema Aquilegiae* (Roum. & Pat.) Grove	Clyde (**3**, vi, 368)

ARABIS ALBIDA

*White Blister	*Cystopus candidus* (Pers.) de Bary	Forth

ARMERIA sp. (Cultivated Sea Pink)		
Rust	*Uromyces Armeriae* Lév.	Forth (Wilson, **7**, xxxi, 359), Clyde (Boyd, **6**, N.S. ii, Proceedings, 8), Tay (White, **1**, vi, 41)
ASPARAGUS PLUMOSUS		
*Root Rot	*Pythium* sp.	Clyde
ASTER spp. (Michaelmas Daisy)		
*Mildew	*Erysiphe Cichoracearum* DC.	Forth
*Stalk Break	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde
*Wilt	*Verticillium Vilmorinii* Westerd. & van Luijk	Solway, Forth, Tay
ATROPA BELLADONNA		
*Root Rot and Wilt	*Phytophthora erythroseptica* Pethybr. var. *Atropae* Alcock	Forth
AUCUBA JAPONICA		
Die Back	*Botrytis cinerea* Pers.	Clyde (Trapp, **3**, xx, 299)
AZALEA, see Rhododendron		
BARTONIA sp.		
*Damping Off	*Pythium complectens* Braun	Forth
BEGONIA spp.		
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth
*Leaf Spot	*Pseudomonas Begoniae* (Buchw.) Stapp	Forth, Clyde
*Damping Off	*Phytophthora* sp. and *Pythium* sp.	Forth
*Root Rot	*Corticium Solani* Bourd. & Galz.	Solway, Clyde
*Leaf Spot	*Gloeosporium Begoniae* Magn.	Forth
*Leaf Spot	*Phyllosticta Begoniae* Brun.	Forth
BERBERIS VULGARIS (Barberry)		
*Mildew	*Microsphaera Berberidis* (DC.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray
*Rust	*Puccinia graminis* Pers.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Orkney
See also *Mahonia*.		
BUXUS SEMPERVIRENS (Box)		
Leaf Fall	*Guignardia Buxi* Desm.	Forth
	Trochila Buxi Capron	Clyde, Tay, Moray
*Rust	*Puccinia Buxi* DC.	Solway, Forth, Tay, Dee, Argyll
CALCEOLARIA sp.		
*Wilt	*Phytophthora* sp.	Forth
CALENDULA sp.		
*Leaf Spot	*Entyloma Calendulae* (Oud.) de Bary	Forth
A form of this fungus has been recorded on *Hieracium vulgatum* in Tay and Dee (Trail, **1**, N.S. iv, 371) and on *H. vulgatum* and *H. sylvaticum* in Clyde (Boyd, **5**, vii, 10; **6**, N.S. iv, 26 and **4**, 1921).		
Rust	*Coleosporium Senecionis* Fr.	Dee; Fide W. C. Moore
CALLISTEPHUS CHINENSIS (Chinese Aster)		
*Wilt	*Phytophthora parasitica* Dast. & *P. cryptogea* Pethybr. & Laff.	Tweed
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Tweed, Forth, Clyde
*Blackleg	*Fusarium conglutinans* Wollenw. var. *Callistephi* Beach	Forth, Clyde

CALLUNA VULGARIS vars. (Heather)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

The occurrence of *Fomes annosus* Fr. on heather in Dee is recorded in **14**, xli, 225.

*Die Back	*Clinterium obturatum* Fr. associated	Forth, Clyde, Argyll

An unidentified rhizomorphic fungus is also associated with this condition, as is the Heather Beetle, *Lochmaea suturalis*.

CAMPANULA spp.

Rust (*C. rotundifolia*)	*Puccinia Campanulae* Carm.	Clyde (**6**, N.S. iv, 126), Tay, Argyll, Dee (Trail, **1**, N.S. iv, 316)
*Rust (*C. rotundifolia, C. glomerata, C. persicifolia*)	*Coleosporium Campanulae* Lév.	Tweed, Forth, Clyde, Tay, Argyll, Dee, Moray
*Leaf Spot (*C. persicifolia, C. rotundifolia*)	*Ramularia macrospora* Fres.	Forth, Clyde, Dee
Leaf Spot (*C. latifolia*)	*Ramularia Campanulae-latifoliae* Allesch.	Clyde (Boyd, **5**, viii, 54)
Leaf Spot (*C. persicifolia*)	*Phyllosticta carpathica* Allesch. & Sydow	Clyde (Boyd, **5**, v, 121)
Leaf Spot (*C. rotundifolia*)	*Septoria obscura* Trail	Clyde (Trail, **1**, N.S. iv, 65)

CENTAUREA CYANUS (Cornflower)

*Rust	*Puccinia Cyani* Pass.	Clyde, Tay

Trail has a record of '*Puccinia suaveolens* var. *Centaureæ* Magnus on *Centaurea Cyanus*, public park at Aberdeen' (1, N.S. iv, 314).

CHEIRANTHUS CHEIRI (Wallflower)

*Breaking of Flower Colour	Probably Brassica Virus 1 K. M. Smith	Forth
*Club Root	*Plasmodiophora Brassicae* Woron.	Forth, Clyde, Ross
*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde, Ross
*Damping Off	*Pythium* sp. and *Rhizopus* sp.	Forth
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde

CHIONODOXA LUCILIAE

Smut	*Ustilago Vaillantii* Tul.	Forth (Boyd, **9**, vii, 185)

CHRYSANTHEMUM INDICUM

*Bronzing and Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde
Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde
*Root Rot	*Pythium megalacanthum* de Bary	Forth, Tay

When severe this rot also invades the basal shoots which would be used as cuttings. Onset of root rot in mature plants leads to malformation of flowers and failure of buds to open.

Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde (**25**, xiv, 559)
*Rust	*Puccinia Chrysanthemi* Roze	Solway, Forth, Clyde, Argyll, Tay
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Mildew	*Oidium Chrysanthemi* Rabenh.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray
*Blotch	*Septoria chrysanthemella* Sacc.	Forth, Clyde
*Leaf Spot	*Phyllosticta* sp. associated	Forth
*Verticillium Stem and Root Rot	*Verticillium* sp.	Forth
*Grey Mould and Bud Rot	*Botrytis cinerea* Pers.	Clyde

CHRYSANTHEMUM INDICUM (*continued*)

*Leaf-fall	*Aphelenchoides ritzema-bosi* (Schwartz) Goodey	Forth, Clyde, Tay

Yellowing caused by sodium chlorate poisoning, resulting from potted plants standing on paths recently treated with this substance as a weed-killer, is an occasional source of enquiry. (For a description of this condition see **24**, xxv, 659.)

CHRYSANTHEMUM MAXIMUM

Leaf Spot	*Septoria cercosporioides* Trail	Clyde (Boyd, **5**, v, 94)

CINERARIA sp.

*Foot Rot	*Phytophthora parasitica* Dast.	Forth
*Mildew	*Oidium* sp.	Tay (McDonald, **18**, 3rd Ser. cv, 111)
*Stem Rot	*Botrytis cinerea* Pers.	Forth

CLARKIA sp.

*Foot Rot	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Solway, Tay

CLEMATIS sp.

*Root Injury	*Anguillulina pratensis* (de Man.) Goffart	Tweed

COTONEASTER sp.

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Tay

CROCUS AUREUS

*Corm Rot	*Fusarium bulbigenum* Cooke & Mass.	Forth

CYCLAMEN sp.

*Crown Rot	*Botrytis cinerea* Pers.	Forth

DAHLIA spp.

*Mosaic	Dahlia Virus 1 K. M. Smith	Forth, Clyde
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde, Tay, Moray
*Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Forth, Clyde
*Leaf Spot	*Entyloma Dahliae* Syd.	Solway, Forth, Clyde, Argyll, Tay

First recorded in 1933; now common and widespread.

*Leaf Spot	*Phyllosticta dahliicola* Brun.	Solway, Clyde
*Wilt	*Verticillium* sp.	Forth
*Grey Mould	*Botrytis cinerea* Pers.	Forth

DELPHINIUM spp.

*Leaf Spotting and Malformation	Lycopersicum Virus 3 K. M. Smith	Tweed (Det. K. M. Smith)
*Black Blotch	*Bacterium Delphinii* Bryan	Forth, Tay, Moray
*Root Rot	*Pythium* sp.	Clyde
*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth, Clyde
*Leaf Spot	*Phyllosticta Ajacis* Thüm.	Clyde; first seen in 1935

DIANTHUS BARBATUS (Sweet William)

*Leaf Spot	*Didymellina Dianthi* C. C. Burt	Forth, Clyde, Moray, Argyll
Leaf Spot	*Septoria sinarum* Speg.	Dee (Trail, **1**, N.S. iii, 91 and 225)

DIANTHUS CARYOPHYLLUS (Carnation)

*Rust	*Uromyces caryophyllinus* Wint.	Clyde

First recorded by Boyd in 1909 (**5**, i, 111)

*Mildew	*Oidium* sp.	Forth
*Leaf Rot	*Heteropatella valtellinensis* (Trav.) Wollenw.	Forth

DIANTHUS CARYOPHYLLUS (Carnation) (*continued*)

*Wilt	*Verticillium cinerescens* Wollenw.	Clyde
*Root Rot	*Fusarium* sp.	Clyde
*Malformed Flowers	*Botrytis cinerea* Pers.	Forth
*Mould	*Cladosporium herbarum* (Link) Fr.	Clyde
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Tay

Anther smut (*Ustilago violacea* (Pers.) Fuckel) has not yet been received on carnation but is common on *Lychnis alba, L. dioica, L. Flos-cuculi, Silene maritima, S. Cucubalus, S. nutans, Stellaria graminea* and *S. palustris* in Tweed, Forth, Clyde, Tay, Dee, Moray.

EREMURUS sp.

*Leaf Blotch	*Pullularia pullulans* (de Bary & Lw.) Berkh.	Forth

Primary cause probably frost.

EUPHORBIA sp.

Mildew	*Sphaerotheca tomentosa* Otth	Tay

FERNS

*Rust (*Aspidium* spp.)	*Milesina Kriegeriana* P. Magn.	Tweed, Forth, Clyde, Argyll, Tay, Moray

For other rusts of native ferns see Wilson (**7**, xxxi, 345) and Hunter (**3**, xx, 116).

*Root Rot (*Pteris Wimsetti*)	*Pythium* sp.	Tay
*Leaf Spots (*Pteris* spp. and *Davallia* sp.)	*Aphelenchoides olesistus* (Ritzema Bos) Goodey.	Forth

FICUS ELASTICA

Leaf Spot	*Gloeosporium elasticum* Cooke & Massee	Clyde (**6**, N.S. iii, Proceedings, 48)

FORSYTHIA SUSPENSA

Leaf Spot	*Phyllosticta Forsythiae* Sacc.	Clyde (Boyd, **5**, i, 114)

GAILLARDIA

Mosaic	Cucumis Virus 1 K. M. Smith	Forth (**26**, xxiii, 56)

GALANTHUS NIVALIS (Snowdrop)

*Bulb Rot	*Penicillium corymbiferum* Westling	Forth (Det. H. H. Bunting)
*Grey Mould	*Botrytis galanthina* (B. & Br.) Sacc.	Tweed, Forth, Tay

GENTIANA MACAULEYI

*Leaf Blight	*Leptothyrium gentianaecolum* Bauml.	Forth, Clyde

GENTIANA SINO-ORNATA

*Leaf and Stem Blight	*Macrophoma* sp.	Solway

GLADIOLUS HYBRIDS

*Scab and Neck Rot	*Bacterium marginatum* McCull.	Tweed, Forth, Tay

This is the commonest disease of gladioli in Scotland and is probably to be found wherever they are cultivated to any extent. Local growers apply the name 'Varnish Pit' to the lesion on the corm, a term which corresponds to the German 'Lack-schorf' and is far more descriptive than 'Scab'.

*Dry Rot	*Sclerotinia Gladioli* Drayt.	Forth, Clyde, Tay
*Hard Rot	*Septoria Gladioli* Passer.	Clyde

A single specimen seen in 1938.

*Core Rot	*Botrytis* sp.	Forth

First recorded in the winter 1938–9 on Dutch corms but subsequently seen in corms of English and Scottish origin and doubtless long established in this country. This fungus does not agree at all points with *Botrytis Gladioli* Kleb., and is best regarded meantime as a strain of *B. cinerea.*

*Storage Rot	*Penicillium Gladioli* McCulloch	Forth, Tay

Only seen in imported corms.

*Leaf Spot	*Heterosporium gracile* Sacc.	Tweed, Forth, Clyde, Tay

GLOXINIA SPECIOSA		
*Mosaic	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde
*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
GODETIA sp.		
*Root Rot	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay
HELIANTHUS sp.		
*Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Dee
HELLEBORUS NIGER (Christmas Rose)		
*Leaf Spot	*Coniothyrium Hellebori* Cooke & Massee	Forth

On the fresh specimen the pycnospores are frequently colourless, in which state the fungus agrees with *Phyllosticta atrozonata* Voss. When dried material is re-examined, however, the spores are all found to have turned brown. The disease affects perianth leaves as well as foliage.

HIPPEASTRUM sp.		
*Red Ring Spot	Lycopersicum Virus 3 K. M. Smith	Tweed, Forth, Moray
HYACINTHUS ORIENTALIS		
*Yellows	*Bacterium Hyacinthi* Wakk.	Forth, Clyde, Tay
*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm.	Forth
*Bulb Rot	*Penicillium corymbiferum* Westling	Forth, Tay (Det. H. H. Bunting)
*Gummosis	Non-pathogenic	Clyde
*Loose-bud	A varietal characteristic recorded in 'Bismarck' and 'L'Innocence'	
*Eelworm injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Clyde, Tay

As all hyacinth bulbs are imported the distribution of these records has little significance.

HYDRANGEA HORTENSIS		
*Mildew	*Microsphaera polonica* Siemaszko (*Oidium* only)	Clyde, Tay
*Mould	*Cladosporium herbarum* (Link) Fr.	Forth
IRIS sp.		
*Leaf Spot	*Didymellina macrospora* Kleb.	Solway, Forth
*Rust	*Puccinia Iridis* (DC.) Wallr.	Forth, Clyde
*Ink Disease	*Mystrosporium adustum* Mass.	Moray
*Storage Rot	*Penicillium* sp.	Forth, Clyde
LABURNUM VULGARE		
*Branch Canker	*Cucurbitaria Laburni* de Not.	Tweed, Forth, Clyde, Tay, Dee, Moray
Leaf Spot	*Phyllosticta Cytisi* Desm.	Dee (Trail, **1**, N.S. iii, 271)
	Ascochyta Kabatiana Trott.	Clyde (**16**, i, 300)

Grove (**16**, 1, 301) says these are the same fungus.

Mildew	*Oidium* sp.	Dee (Farquharson, **2**, 1911, 242)
Leaf Spot	*Gloeosporium Cytisi* B. & Br.	Tay (Stevenson, **1** vi, 118)

The record of *Calonectria Pseudopeziza* in the previous list cannot be substantiated and should be deleted.

LATHYRUS ODORATUS (Sweet Pea)		
*Stripe	Unidentified Virus	Forth, Clyde, Tay, Dee, Moray
Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde
*Root Rot	*Aphanomyces euteiches* Drechsl.	Tweed, Solway, Forth, Clyde, Argyll, Tay

LATHYRUS ODORATUS (Sweet Pea) *(continued)*

*Downy Mildew	*Peronospora Viciae* (Berk.) de Bary	Tweed, Forth, Moray
*Foot Rot	*Ascochyta pinodella* L. K. Jones	Clyde
*Leaf Spot	*Ascochyta Pisi* Lib.	Forth, Clyde
*Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Forth, Clyde

Pythium spp., *Corticium Solani* and *Fusarium* spp. have also been found associated with root rots.

*White Mould	*Erostrotheca multiformis* Martin & Charles (*Cladosporium* stage)	Tweed

LAVANDULA (Lavender)

Shab	*Phoma Lavandulae* Gabot	Forth

LIGUSTRUM VULGARE (Privet)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde, Tay, Moray
Leaf Spot	*Phyllosticta Ligustri* Sacc.	Clyde, Dee (Trail, **1**, N.S. iv, 64 and N.S. iii, 118)

LILIUM spp.

*Virus Diseases. Two virus diseases of lilies are recognized in England, viz. Rosette, caused by Lilium Virus 1 K. M. Smith, and Mosaic, caused by Cucumis Virus 1 K. M. Smith. Scottish records probably refer to the latter, but the diseases have not been studied and differentiated in this country. Probable virus diseases have been recorded in Scotland on *Lilium auratum*, *L. Brownii*, *L. candidum*, *L. centrifolium*, *L. chalcedonicum*, *L. formosum*, *L. melpomene*, *L. sargentia* and *L. tigrinum*.

*Foot Rot (*L. auratum*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Clyde
*Root Rot	*Pythium* spp.	Forth
*Crown Rot (*L. auratum*)	*Corticium Solani* Bourd. & Galz.	Forth
*The Lily Disease	*Botrytis elliptica* (Berk.) Cooke	Solway, Forth, Tay, Moray

On *Lilium aurantiacum*, *L. candidum*, *L. dauricum*, *L. Hansonii*, *L. Martagon*, *L. pardalinum*, *L. platyphyllum*, *L. regale*, *L. szovitsianum*, *L. testaceum*, and *L. tigrinum*.

*Stem Rot (*L. Hansonii*)	*Fusarium* sp. associated	Clyde (Colonsay)

LUPINUS sp.

*Sore Shin	Cucumis Virus 1 K. M. Smith	Forth (Det. K. M. Smith)
*Mildew	*Erysiphe Polygoni* DC.	Forth

MAHONIA AQUIFOLIA

*Rust	*Puccinia mirabilissima* Peck	Tweed, Solway, Forth, Clyde, Tay

First recorded in 1922 (7, xxviii, 164).

Leaf Spots	*Phyllosticta mahoniana* (Sacc.) Allesch.	Solway (Boyd, **3**, iii, 367), Clyde (Boyd, **5**, iv, 125), Dee (Trail, **1**, N.S. iv, 280)
	Phyllosticta Mahoniae Sacc. & Speg.	Dee (Trail, **1**, N.S. iv, 280)

MATTHIOLA sp. (Stock)

*Breaking of Flower Colour	Probably Brassica Virus 1 K. M. Smith	Forth
*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
*Downy Mildew	*Peronospora Matthiolae* Gäum.	Forth, Tay
*Wire Stem and Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth, Clyde, Tay
*Blackleg	*Phoma lingam* (Tode) Desm.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Tay

MECONOPSIS spp.

*Smother	*Mucilago spongiosa* (Leyss) Morgan	Tweed
*Root Rot (*M. Wallichi*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay

MECONOPSIS spp. (*continued*)

*Root Rot	*Phytophthora verrucosa* Alcock & Foister	Forth
*Damping Off	*Phytophthora parasitica* Dast.	Forth
*Mildew	*Peronospora arborescens* (Berk.) de Bary	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray
*Stem Rot and Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth

MUSCARI POLYANTHUM

Rust	*Uromyces Scillarum* Wint.	Forth (Wilson, **7**, xxxi, 365)

MYOSOTIS sp. (Forget-me-not)

Downy Mildew	*Peronospora Myosotidis* de Bary	Clyde (Boyd, **6**, N.S. iv, 29), Dee (**1**, N.S. iv, 276)

The published records relate to *Myosotis arvensis*, *M. caespitosa* and *M. versicolor*.

*Mildew	*Erysiphe horridula* (Wallr.) Lév.	Forth, Tay
Leaf Spot	*Entyloma Fergussoni* (B. & Br.) Plowr.	Solway (**4**, 1909), Clyde (Boyd, **7**, N.S. viii, 267; iv, 26), Tay, Dee, Moray (Trail, **1**, N.S. iv, 370)

All published records seem to relate to wild plants of *Myosotis arvensis*, *M. caespitosa* and *M. palustris*.

MYRTUS sp. (Myrtle)

Leaf Spot	*Cercospora Myrti* Erikss.	Clyde (**3**, vi, 157)

NARCISSUS spp.

*Stripe	? Tulipa Virus 1 K. M. Smith	Forth
*Root Rot	*Pythium intermedium* de Bary	Clyde (Det. S. F. Ashby)
*Fire	*Sclerotinia polyblastis* Gregory (*Botrytis* stage)	Forth, Clyde
*Smoulder	*Botrytis narcissicola* Kleb.	Forth, Clyde, Tay
*Leaf Scorch	*Stagonospora Curtisii* (Berk.) Sacc.	Clyde
*White Mould	*Ramularia vallisumbrosae* Cav.	Tweed, Clyde
*Bulb Rot	*Fusarium bulbigenum* Cooke & Massee	Tweed, Clyde, Tay
*Storage Rot	*Penicillium* sp. and *Trichoderma viride* Pers.	Forth

Usually found in damaged bulbs or associated with mites.

*Small Speck	*Sclerotium* sp.	Forth

This organism, the sclerotia of which are commonly found on the dry outer scales of *Narcissus* and *Galanthus* bulbs, closely resembles *Sclerotinia Gladioli*, but its perfect stage has not yet been obtained. In pure cultures on sterilized wheat grains it produces receptive bodies nearly 1 cm. long but so far a strain forming microconidia has not been secured. The fungus is probably not a parasite.

*Eelworm injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Tweed, Forth, Clyde, Tay

NEMESIA sp.

*Root Rot	*Phytophthora parasitica* Dast.	Forth

NYMPHAEA sp. (Water Lily)

Leaf Spot	*Gloeosporium* sp. (probably *G Nymphaearum* Allesch.)	Forth

OXALIS ROSEA AND *O. CORNICULATA*

*Mildew	*Oidium Oxalidis* McAlp.	Forth

PAEONIA sp.

*Leaf Blotch	*Septoria Paeoniae* West. var. *berolinensis* Allesch.	Forth, Clyde
*Wilt	*Botrytis Paeoniae* Oud.	Forth, Tay

PAPAVER SOMNIFERUM (Opium Poppy)		
*Mildew	*Peronospora arborescens* (Berk.) de Bary	Tay
Also recorded on *Papaver dubium* in Forth and by Trail in Dee, Tay and Moray (**1**, N.S. iii, 81).		
PELARGONIUM ZONALE		
*Leaf Curl	Pelargonium Virus 1 K. M. Smith	Forth, Clyde
*Blackleg	*Pythium* sp.	Tweed
*Leaf and Stem Rot	*Botrytis cinerea* Pers.	Forth, Clyde
*Oedema	Non-parasitic	Solway, Forth
PETASITES JAPONICUS AND *P. PALMATUS*		
Rust	*Coleosporium Petasitis* Lév.	Tweed (Wilson, **3**, ix, 142)
PETUNIA sp.		
*Foot-rot	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
PHILADELPHUS CORONARIUS		
Leaf Spot	*Ascochyta Philadelphi* Sacc. & Speg.	Solway (**4**, 1911), Forth (**9**, vi, 273), Clyde (**5**, ii, 95), Tay (**4**, 1910)
PHLOX spp.		
*Damping Off	*Phytophthora parasitica* Dast.	Forth
*Stem Rot	*Phoma ? Phlogis* Bourn.	Forth
*Leaf Spot	*Septoria divaricatae* Ell. & Ev.	Forth
The specimen in question yielded spores up to $58 \times 1\,\mu$.		
*Black Mould	*Cladosporium herbarum* (Link) Fr.	Forth
*Eelworm Disease	*Anguillulina dipsaci* (Kuhn) Gerv. & v. Ben.	Tweed, Forth, Clyde, Tay
PHORMIUM TENAX (New Zealand Flax)		
*Leaf Spot	*Glomerella phacidiomorpha* (Cesati) Petrak	Solway
POTENTILLA sp. (Gibson's Scarlet)		
Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde
PRIMULA: Hardy spp.		
*Foot Rot and Root Rot (*Primula japonica*)	*Phytophthora Cactorum* (Leb. & Cohn) var. *applanatum* Chester	Tweed
*Foot Rot	*Phytophthora parasitica* Dast.	Moray
*Foot Rot	*Phytophthora* sp. associated with *Thielaviopsis basicola* (Berk.) Ferraris and *Corticium Solani* Bourd. & Galz.	Forth
On *Primula ianthina*, *P. leuchochnoa*, *P. muliensis*, *P. russeola*, *P. sinoplantaginea*, *P. sinopurpurea*, *P. sonchifolia*, and *P. szechuanica*.		
*Also *P. verrucosa* Alcock & Foister on *Primula* seedlings		Forth
Downy Mildew (*Primula vulgaris*)	*Peronospora Oerteliana* Kühn	Forth, Tay, Dee, Moray, Ross (**13**, 278), Clyde (Boyd, **5**, iv, 124)
Recorded as *Peronospora candida* Fuckel		
Ovary Smut	*Tuburcinia primulicola* (Magn.) Bref.	Dee (Trail, **1**, N.S. iv, 370)
*Rust	*Puccinia Primulae* Duby	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross
*Leaf Spot	*Cercosporella Primulae* Allesch.	Tweed
*Leaf Spot	*Ovularia primulana* Karst.	Tweed, Forth, Clyde, Argyll, Tay, Dee
*Leaf Spot	*Ascochyta Primulae* Trail	Tay, Dee
*Leaf Spot	*Phyllosticta primulicola* Desm.	Forth
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Clyde, Dee, Moray

PRIMULA: Glasshouse species		
*'Mosaic'	Perhaps Cucumis Virus 1 or Lycopersicum Virus 3 K. M. Smith	Clyde
*Crown Rot (*P. obconica*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay
*Damping Off (*P. malacoides*)	*Phytophthora* sp.	Clyde
PRUNUS AMYGDALUS (Almond)		
*Leaf Curl	*Taphrina deformans* (Berk.) Tul.	Forth, Clyde, Tay
PRUNUS BESSEYI (American Sand Cherry)		
*Wither Tip	*Sclerotinia laxa* Aderh. & Ruhl.	Clyde
PRUNUS INCISA		
*Die Back	*Sphaeropsis Malorum* Berk.	Tay
PRUNUS LAUROCERASUS (Cherry Laurel)		
*Leaf Spot	*Trochila Laurocerasi* (Desm.) Fr.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
PYRACANTHUS COCCINEA var. *LAELANDEI*		
*Scab	*Fusicladium pirinum* (Lib.) Fuckel var. *Pyracanthae* Thüm.	Clyde, Tay
PYRETHRUM ROSEUM		
*Root Rot	*Corticium Solani* Bourd. & Galz.	Forth
RESEDA ODORATA (Mignonette)		
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth
RHUS sp. (Sumach)		
*Leaf Spot	*Phyllosticta* sp.	Tweed
RHODODENDRON spp.		
*Leaf Blight and Canker	*Lophodermium melaleucum* Fr.	Tweed
*Twig Blight	*Lembosia* sp.	Clyde
*Gall (on *R. ferrugineum*)	*Exobasidium Vaccinii* (Fuckel) Woron.	Solway, Forth, Clyde, Tay, Dee
Rust (on *R. hirsutum*)	*Chrysomyxa Rhododendri* de Bary	Clyde (5, v, 126)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth, Moray
*Leaf Scorch	*Sporocybe Azaleae* (Peck) Sacc.	Forth, Clyde, Tay, Dee, Moray
*Leaf Spots	*Phyllosticta Rhododendri* Westend.	Forth, Tay
	Phoma Rhodorae Cooke	Clyde (**16**, i, 100)
	Macrophoma cylindrospora Berl. & Vogl.	Clyde
	Diplodia Rhododendri Westend.	Dee (Trail, **1**, N.S. iii, 45)
Some of these are probably saprophytes living on leaf lesions due to other causes.		
*Stem Canker	*Botrytis cinerea* Pers.	Argyll
RICHARDIA AFRICANA (Arum Lily)		
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde, Tay, Moray
Leaf Spot	*Phyllosticta Richardiae* Halsted	Tay (Macdonald, **7**, xxxii, 556)
ROMNEYA COULTHERI		
*Foot Rot	*Phytophthora* sp.	Clyde
ROSA spp.		
*Root Rot	*Phytophthora* sp.	Forth
*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross

ROSA spp. (*continued*)

*Black Spot	*Diplocarpon Rosae* Wolf (*Actinonema* stage only)	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Stem Canker	*Leptosphaeria Coniothyrium* (Fuckel) Sacc. (*Coniothyrium* stage only)	Solway, Forth, Tay
*Canker	'*Botryosphaeria* sp.'	Clyde (a single specimen in 1934)

Probably this fungus was *Griphosphaeria corticola* (Fuckel) v. Hohnel, which Brooks and el Alaily have shown to be the perfect stage of the rose form of *Coryneum microstictum* B. & Br. As no specimens were kept the matter cannot now be decided. Die Back associated with *Coryneum microstictum* has been recorded from Forth, Clyde, Tay and Dee.

*Rust	*Phragmidium mucronatum* (Pers.) Schlecht.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Orkney

Most published records relate to *Rosa canina* and *R. tomentosa*, but the fungus is common on cultivated roses.

Leaf Spot	*Sphaceloma Rosarum* (Passer.) Jenk.	Forth, Moray
Leaf Spot	*Septoria Rosae* Desm.	Clyde (Trail, **1**, N.S. iv, 65), Tay, Dee (**1**, N.S. iii, 224), Moray (**4**, 1912)

Probably only on wild roses (*Rosa canina* and *R. tomentosa*).

*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth, Tay
*Die Back	*Cryptosporium minimum* Laub.	Tay

Recorded on a rambler rose, the primary injury to which was probably due to frost.

SAXIFRAGA spp. (Cultivated Saxifrages)

Rust	*Puccinia Pazschkei* Dietel (on *Saxifraga aizoon* var. *cultrata*, *S. cotyledon* var. *Caterhamensis*, *S. Hostii* and var. *rhaetica*, and *S. longifolia*)	Forth, Clyde (Wilson, **7**, xxxi, 383–4), Tay (Macdonald, **7**, xxxii, 556)

SCHIZANTHUS sp.

*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
*Root Rot	*Pythium* sp.	Clyde
*Mildew	*Erysiphe Cichoracearum* DC.	Forth
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Clyde

SCILLA spp.

*Smut (*S. verna*)	*Ustilago Vaillantii* Tul.	Clyde, Forth
*Rust (*S. nutans*)	*Uromyces Scillarum* Wint.	Tweed, Solway, Forth, Clyde, Tay, Moray
Leaf Spot (*S. nutans*)	*Septoria Scillae* Westend.	Clyde (**3**, vi, 49)
Bulb Rot	*Penicillium cyclopium* Westling	Tay (recorded by Macfarlane on bulbs imported from Holland, **7**, xxxii, 542)

SENECIO SMITHII

Rust	*Coleosporium Senecionis* Fr.	Argyll (Wilson, **3**, ix, 141)

STRANSVAESIA DAVIDIANA

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

SYRINGA VULGARIS (Lilac)

*'Mosaic'		Forth

A single case in 1936. Possibly this was the Leaf Curl Virus disease described by K. M. Smith (**18**, cvii, 144).

*Wilt	*Phytophthora Syringae* Kleb.	Forth, Dee

Recorded by Berkeley as *Ovularia Syringae* n.sp. from Dee in 1881 (**18**, xvi, 665).

Leaf Spot	*Phyllosticta Syringae* Westend.	Clyde (Boyd, **5**, ii, 95), Dee (Trail, **1**, N.S. iv, 280)
*Grey Mould	*Botrytis cinerea* Pers.	Clyde

Keith (**1**, ii, 247) records *Polyporus radiatus* (Sow.) Fr. on this host in Moray.

TROPAEOLUM MAJUS (Nasturtium)

*Leaf Spot	Unidentified bacterium	Clyde

TULIPA sp.

*Breaking	Tulipa Virus 1 K. M. Smith	Forth
*Shanking	*Phytophthora cryptogea* Pethybr. & Laff.	Forth, Clyde
	Phytophthora erythroseptica Pethybr.	Clyde
*Rust	*Puccinia Prostii* Moug.	Forth

Occurs only on *Tulipa sylvestris* at the Royal Botanic Garden, Edinburgh.

*Fire	*Botrytis Tulipae* (Lib.) Lind.	Forth, Clyde, Tay, Dee, Moray
*Grey Bulb Rot	*Sclerotium Tuliparum* Kleb.	Forth, Clyde, Tay
*Bulb Rot	*Fusarium* sp. associated	Forth
*Chalking	*Penicillium* sp. associated (see Moore, **30**, cxvii, 40–41)	Forth, Tay
*Hard Base	Non-parasitic	Tay
*Blindness	Non-parasitic	Forth, Moray

Commonly attributed to heating in transit or in storage.

TURF (Various Grasses)

*Red Leaf and Root	*Cladochytrium caespitis* Griffon & Maublanc (Det. G. H. Pethybridge)	Forth, Tay
*Smother	*Mucilago spongiosa* (Leyss) Morgan	Forth, Clyde
*Brown Patch	*Calonectria graminicola* (B. & Br.) Wollenw. (*Fusarium* stage only)	Forth, Clyde, Moray
*Brown Patch	*Sclerotinia homoeocarpa* Bennett (*Rhizoctonia* stage only)	Forth, Clyde
*Scorch	*Corticium fuciforme* (Berk.) Wakef. (*Isaria* stage only)	Solway, Forth, Clyde, Tay
*Fairy Ring	*Lycoperdon* sp.	Forth, Clyde

VERONICA (Shrubby spp.)

*Root Rot (*V. propinqua*)	*Armillaria mellea* (Vahl) Fr.	Forth

Shrubby species of *Veronica* suffered severely from the hard frosts of January and February 1940, and often all but the main stem of the plant was killed.

VIOLA spp. (including Pansy, Violet)

*Root Rot	*Aphanomyces euteiches* Dreschsl.	Tweed, Forth, Clyde, Tay, Dee
*Root Rot	*Phytophthora Cactorum* (Lib. & Cohn) Schroet.	Forth
Downy Mildew (*V. tricolor* and *V. arvensis*)	*Peronospora Violae* de Bary	Clyde (Boyd, **6**, N.S. v, 162), Dee, (Trail, **1**, N.S. iii, 356), Orkney (Trail, **1**, N.S. iv, 31)
*Rust	*Puccinia Violae* (Schum.) DC.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland, Orkney

Almost all published records are on wild violets (*Viola canina*, *V. hirta*, *V. sylvatica* and *V. Riviniana*) but Wilson, **7**, xxxi, 382 has it on *V. odorata*.

*Rust (*V. tricolor*, *V. lutea* var. *amoena* and *V. Curtisii* var. *Fosteri*	*Puccinia depauperans* Sydow	Solway, Forth, Clyde, Tay, Moray
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth, Tay
*Mildew	*Oidium* sp.	Forth, Clyde

VIOLA spp. (*continued*)

*Leaf Spots (*V. odorata*)	*Phyllosticta Violae* Desm.	Argyll (White, **1**, vi, 161), Tay (**1**, v, 276), Dee (Stevenson, **1**, N.S. i, 181)

A species of *Phoma* having spores about $9 \times 2\mu$, apparently not *Darluca filum* (see Grove, **16**, i, 113), has occurred on cultivated Violas in Forth and Tay.

*(*V. odorata*)	*Alternaria* sp.	Clyde
*(*V. sylvatica* and *V. Riviniana*)	*Ramularia Violae* Trail	Solway (**4**, 1909), Clyde, Argyll (Trail, **1**, N.S. iv, 67), Tay (**1**, N.S. iv, 275), Dee (Trail, **1**, N.S. iv, 74), Moray (**4**, 1912)
*Cultivated hybrids	*Ramularia lactea* Desm.	Solway, Clyde, Moray
*Cultivated hybrids	*Ramularia deflectens* Bres.	Clyde
(*V. tricolor*)	*Ramularia agrestis* Sacc.	Dee (Trail, **1**, N.S. iii, 41)
(*V. odorata*)	*Gloeosporium Violae* B. & Br.	Forth (Trail, **1**, N.S. iii, 267) (probably=*P. Violae* above, see Grove, **16**, ii, 229)
*(*V. odorata*)	*Ascochyta Violae* Sacc. & Speg.	Solway, Forth
(*V. sylvatica*)	*Septoria Violae* Westend.	Clyde (**4**, 1928), Tay (White, **1**, v, 92), Dee (Stevenson & Trail, **1**, N.S. ii, 187), Moray (**4**, 1927)
*(*V. sylvatica* and *V. Riviniana*)	*Urocystis Violae* (Sow.) Fisch. de Waldh.	Tweed, Dee, Moray

There appears to be some confusion in the nomenclature of leaf-spot fungi on *Viola* spp., and it has seemed best to include all the species recorded, whether on cultivated plants or not, as their host ranges are uncertain. Species on *V. palustris* only are omitted.

ZINNIA sp.

*Foot Rot	*Phytophthora cryptogea* Pethybr.	Forth
*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth

TREES

ABIES NOBILIS (Noble Fir)

Root Rot	*Armillaria mellea* (Vahl) Fr.	Dee (Ritchie, **14**, xlvi, 132)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc. ? (Wilson & Waldie, **17**, xl, 34)

Dasyscypha resinaria Rehm is reported on *Abies nobilis* from Tay (**4**, 1930).

ABIES NORMANNIANA (Caucasian Fir)

Witches' Broom	*Melampsorella Caryophyllacearum* Schroet.	Tay (Wilson, **3**, ix, 140)

ABIES PECTINATA (European Silver Fir)

Scorch	*Acanthostigma parasiticum* Sacc.	Clyde (H. Watson, **14**, xlvii, 71)
Die Back	*Rehmelliopsis bohemica* Bub. & Kab.	Clyde, Moray
Rust	*Aecidium pseudocolumnare* Kühn	Tweed, Moray (Wilson, **7**, xxxi, 433)

In Scotland this appears to be the aecidial stage of *Milesina Kriegeriana* P. Magn.

Witches' Broom	*Melampsorella Caryophyllacearum* Schroet.	Solway (**4**, 1924 and 1911), Clyde (6 N.S. viii, 110)
? Canker	*Aleurodiscus amorphus* (Pers.) Rabenh.	Solway (**4**, 1924)

This fungus has also been reported from Tay (**1**, iii, 270 and **1**, v, 273) and Dee (**1**, N.S. iii, 168) in dead spruce branches lying on the ground and on dead silver fir.

Defoliation	*Rhizosphaera Kalkhoffii* Bubák	(Wilson & Waldie, **17**, xl, 34)

ACER PSEUDOPLATANUS (Sycamore)

*Mildew	*Uncinula Aceris* (DC.) Sacc.	Solway, Forth, Clyde, Tay, Dee, Moray
*Tar Spot	*Rhytisma acerinum* (Pers.) Fr.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross

The form *Rhytisma punctatum* (Pers.) Fr. is on record from Solway, Clyde, Tay, Dee.

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth

ACER PSEUDOPLATANUS (Sycamore) (*continued*)

*Heart Rot	*Polyporus squamosus* (Huds.) Fr.	Forth, Clyde
Leaf Spot	*Phleospora Aceris* Sacc.	Forth (Boyd, **9**, vi, 343), Clyde (Boyd, **5**, i, 52), Tay (Trail, **1**, N.S. iii, 232), Moray (**4**, 1912)

Also on *Acer campestre* in Dee (Trail, **1**, N.S. iv, 281).

Leaf Blotch	*Cristulariella depraedens* (Cooke) v. Hohn.	Forth (**9**, vi, 273), Clyde (Boyd, **5**, iv, 16), Tay (**4**, 1910)
*Slime Flux	*Oospora* sp., associated	Forth

The record of *Gnomonia veneta* in the previous list cannot be substantiated and should be deleted.

ALNUS GLUTINOSA (Alder)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	? Dee (Trail, **6**, N.S. iii, 12)
*Leaf Curl	*Taphrina Tosquinetii* (Westend.) Magn.	Forth, Clyde, Argyll, Tay, Dee, Moray
*Leaf Spot	*Taphrina Sadebeckii* Johans.	Forth, Clyde, Argyll, Dee (Trail, **1**, N.S. iv, 61 and 278)

Trail (**1**, N.S. iv, 277) also has '*Exoascus Alni* B. & Br. on female catkins of *Alnus glutinosa*' in Dee and Orkney.

*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Tay
*Die Back and Heart Rot	*Polyporus radiatus* (Sow.) Fr.	Tweed, Solway, Clyde, Tay, Moray
Rust	*Melampsoridium Alni* Diet.	Clyde, Tay, Dee (Wilson, **7**, xxxi, 425)
*Leaf Spot	*Leptothyrium alneum* Sacc.	Forth, Clyde, Argyll, Tay, Dee, Moray
*Root nodules	*Schinzia Alni* Woron.	Clyde, Tay, Dee, Moray

These doubtless occur wherever alders are found.

BETULA ALBA (Birch)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	Forth (Boyd, **9**, vii, 187), Clyde (**5**, vii, 13), Moray (Keith, **1**, v, 9), Orkney (Trail, **6**, N.S. iii, 12)
*Witches' Broom	*Taphrina turgidus* (Fuckel) Sadeb.	Tweed, Solway, Forth, Clyde, Argyll, Dee, Moray
*White Heart Rot	*Fomes fomentarius* (L.) Fr.	Tweed, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
Heart Rot	*Fomes annosus* Fr.	Clyde, Dee (**4**, 1932 and 1931)
*Brown Cubical Rot	*Polyporus betulinus* (Bull.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Ross
*Rust	*Melampsoridium betulinum* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland

CASTANEA VESCA (Spanish Chestnut)

*Leaf Spot	*Septoria castaneicola* Desm.	Clyde, Moray

Fistulina hepatica (Huds.) Fr. has been recorded on this host in Forth (**9**, iii, 45) and Tay (**10**, vi, Proceedings, 144).

CEDRUS spp. (Cedars)

Canker	*Phomopsis Pseudotsugae* Wilson	Loc.? (Wilson, **18**, lxxxviii, 412)

CORYLUS AVELLANA (Hazel)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	Tay (**4**, 1906)
Leaf Spot	*Gnomoniella Coryli* (Batsch) Sacc.	Argyll (White, **1**, vi, 162), Moray (Keith, **1**, v, 15)
Leaf Spot	*Labrella Coryli* (Rabenh.) Sacc.	Clyde (Boyd, **5**, viii, 56)
Leaf Spot	*Septoria Avellanae* B. & Br.	Clyde (Trail, **1**, N.S. iv, 65)

CRATAEGUS spp. (Hawthorn)

*Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
*Rust	*Gymnosporangium clavariaeforme* (Jacq.) DC.	Tweed, Solway, Forth, Tay, Dee, Moray
*Leaf Blotch	*Sclerotinia Crataegi* Magn.	Clyde (Fide A. Smith)
Leaf Curl	*Taphrina bullata* (Berk.) Tul.	Dee (Trail, **1**, N.S. iii, 172)
Leaf Spot	*Phleospora Oxyacanthae* (Kunze & Schmidt) Wallr.	Solway (**4**, 1909), Tay (**13**, 216)

*Witches' Brooms of unknown origin have been observed on Hawthorn in Tweed and Tay. They were first recorded in 'West Fife' by Robertson (**7**, xxi, 313, 1900), who noted similar structures on ash, larch and *Abies nobilis*.

FAGUS SYLVATICUS (Beech)

*Heart Rot	*Fomes fomentarius* (L.) Fr.	Solway, Clyde
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth, Clyde

FRAXINUS EXCELSIOR (Ash)

*Canker	Probably *Bacterium Savastanoi* E. F. Sm. var. *Fraxini* N. A. Brown	Tweed, Solway, Forth, Clyde, Argyll

The common ash canker is assumed to be due to the above organism, but *Nectria galligena* Bres. is on record from ash in Clyde (**4**, 1932).

*White Rot	*Polyporus hispidus* (Bull.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray

Ganoderma applanatum (Pers.) Pat. common on dead wood, was recorded 'on a living ash tree' from Moray (Keith, **1**, ii, 247). *Fomes fraxineus* (Bull.) Fr. is on record on old ash from Tay and Dee (**13**, 138) and *Polyporus squamosus* (Huds.) Fr. on ash trunks from Moray (**1**, ii, 247).

*Brown Rot	*Pholiota adiposa* Fr.	Forth, Clyde
Canker Die Back	*Phomopsis scobina* (Cooke) v. Höhn. *Phomopsis controversa* (Sacc.) Trav.	Tweed, Solway, Forth, Tay, Moray (Macdonald & Russell, **7**, xxxii, 341)

JUNIPERUS COMMUNIS (Juniper)

Leaf Spot	*Keithia tetraspora* (Phil. & Keith) Sacc.	Tay (Menzies, **10**, vii, 27), Moray (Phillips & Keith, **18**, xiv, 308)
*Rust	*Gymnosporangium clavariaeforme* (Jacq.) DC.	Tweed, Solway, Forth, Tay, Dee, Moray
	Gymnosporangium Juniperi Link	Solway, Dee, Moray (Trail, **1**, N.S. iv, 321)
*Damping Off	*Corticium Solani* Bourd. & Galz.	Forth

LARIX EUROPAEA (Larch)

*Canker	*Dasyscypha Wilkommii* (Hart.) Rehm	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
*Leaf Cast	*Meria Laricis* Vuill.	Solway
Rust	*Caeoma Laricis* Plowr.	Clyde (Boyd, **5**, viii, 188), Dee (Trail, **1**, N.S. iii, 356), Moray (Keith, **1**, N.S. i, 271), Tay (**4**, 1925)

This is the collective name for the aecidial stage of a number of species of *Melampsora*. For the other stages see poplars and willows.

Rust	*Peridermium Laricis* (Kleb.) Arth.	Tay, Moray (Borthwick & Wilson **17**, xxvii, 198)
Heart Rot	*Fomes annosus* Fr.	'Fifeshire' (M'Hardy, **14**, xliii, 18), Moray (Keith, **1**, ii, 247)

LARIX LEPTOLEPIS (Japanese Larch)

Canker	*Dasyscypha Wilkommii* (Hart.) Rehm	Solway (Murray, **12**, xvii, 386), Forth (Borthwick, **28**, v, 23), Tay (Pitcaithley, **10**, iii, 37)

Also on *Larix occidentalis* (Borthwick, **28**, v, 23) in Tay.

Rust	*Caeoma Laricis* Plowr.	Clyde (Wilson, **7**, xxxi, 422)
Canker	*Phomopsis Pseudotsugae* Wilson	Tweed (Wilson, **17**, xxxv, 73)
Grey Mould	*Botrytis Douglasii* Tub.	Forth (Wilson, **3**, vii, 85)

LIRIODENDRON TULIPIFERA (Tulip Tree)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

PICEA EXCELSA (Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Moray (Watson, **14**, xxxi, 72)
Leaf Scorch	*Lophodermellina macrospora* (Hartig) Tehon	Moray (Watson, **14**, xxxl, 72)
Seedling Blight	*Rosellinia* cf. *aquila* (Fr.) dè Not.	Loc. ? (Wilson, **17**, xxxvi, 226)
Canker	*Dasyscypha calyciformis* (Willd.) Rehm	Tweed, Forth (Wilson, **3**, vii, 79)
*Rust	*Chrysomyxa Abietis* Unger	Tweed, Solway, Clyde, Argyll, Tay, Dee, Moray

First recorded in 1911.

*Rust	*Chrysomyxa Rhododendri* de Bary	Solway, Clyde, Dee
Rust	*Thecopsora areolata* Magn.	Forth, Solway (Wilson, **7**, xxxi, 429), Tweed, Clyde, Tay, Argyll, Moray (Trail, **1**, N.S. iv, 327), Dee (Borthwick, **7**, xxiii, 113)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth
Heart Rot	*Fomes annosus* Fr.	Moray (Watson, **14**, xxxi, 72)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc. ? (Wilson & Waldie, **17**, xl, 34)

PICEA PUNGENS (Blue Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Tay (Borthwick, **28**, iv, 259)
*Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Forth, Clyde

First recorded on *Picea p. argentea* in 1922; also on *P. nigra*, *P. alba*, *P. orientalis* and *P. Schrenkiana* (Wilson & Waldie, **17**, xl, 34).

PICEA SITCHENSIS (Sitka Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Clyde (**4**, 1932)
Rust	*Chrysomyxa Abietis* Unger	Tweed (Wilson, **7**, xxxi, 411)
*Smother	*Phylacteria terrestris* (Ehrh.) Big. & Guill.	Moray (Det. Miss E. M. Wakefield)
Brown Rot	*Polyporus Schweinitzii* Fr.	Tay (Murray, **17**, xxx, 56)
Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	Moray (Watson, **14**, xl, 58)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Clyde (Wilson & Waldie, **17**, xl, 34)

PINUS AUSTRIACA (Austrian Pine)

Rust	*Coleosporium* sp.	Moray (Keith, **1**, N.S. i, 271)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc. ? (Wilson & Waldie, **17**, xl, 34)

Also on *Pinus montana*.

An interesting case of fasciation in *Pinus austriaca* is recorded by Forgan in **2**, 1892, 203.

Die Back	*Brunchorstia destruens* Erikss.	Tweed, Solway, Clyde, Tay, Dee, Moray (Waldie, **17**, l, 120)

Also recorded on *Pinus Cembra*, *P. Laricio* and *P. montana*.

PINUS MONTICOLA (Western White Pine)

*Leaf Cast	*Lophodermium Pinastri* (Schr.) Chev.	Tweed
*Rust	*Cronartium ribicola* Fisch. de Waldh.	Tweed, Solway, Tay

PINUS STROBUS (White Pine)

Canker	*Dasyscypha subtilissima* Cooke	Dee (Farquharson, **2**, 1911, 242)
Leaf Cast	*Hypoderma Desmazierii* Duby	Tay (Wilson, **3**, vii, 81), Dee (Farquharson, **2**, 1911, 242), Clyde (4, 1932)

This fungus has been recorded as *Hypoderma brachysporum* (Rostr.) Tubeuf and *H. strobicola* Tubeuf.

Rust	*Cronartium ribicola* Fisch. de Waldh.	Solway (Boyd, **5**, iv, 87)

This rust is also known on *Pinus Cembra*, *P. Lambertiana* in Tay (Wilson, **3**, vii, 83), *P. Ayacahuite*, *P. parviflora* in Solway (at Culzean Castle, **4**, 1926), *P. excelsa* and *P. flexilis* (Wilson, **7**, xxxi, 412).

PINUS SYLVESTRIS (Scotch Pine)

*Leaf Cast	*Lophodermium Pinastri* (Schr.) Chev.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll, Ross
Leaf Cast	*Hypoderma pinicola* Brunch.	Argyll (Wilson, **3**, vii, 79)
Blue Stain	*Ceratostomella Pini* Münch and *C. Piceae* Munch	Tweed, Forth, Dee, Moray (MacCallum, **3**, vii, 232)
Canker	*Dasyscypha subtilissima* Cooke	Solway (**4**, 1924), Forth, Clyde, Tay (Borthwick & Wilson, **17**, xxix, 184)
Rust	*Peridermium Pini* Chev.	Tweed, Forth, Tay, Moray (**13**, 256), Dee (Stevenson, **1**, vi, 31)
Rust	*Coleosporium* spp.	Tay (White, **1**, v, 323), Dee (Stevenson, **1**, vi, 31), Moray (Keith, **1**, N.S. i, 271)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Solway, Forth, Clyde, Tay, Dee
Red Rot	*Fomes annosus* Fr.	Tweed (Wilson, **3**, xiii, 81), Moray (Boyd, **5**, i, 33), Tay (McIntosh, **10**, iv, Proceedings, 182)
Brown Rot	*Polyporus Schweinitzii* Fr.	Forth (Stevenson, **1**, v, 23), Clyde, Tay, Moray (Stevenson, **13**, 130)

**Sparassis crispa* (Wulf) Fr. is possibly parasitic on Scotch pine in Tweed, Forth, Tay and Moray.

Trametes Pini (Brot.) Fr. has been recorded 'on living trees of *P. sylvestris*' from Moray (**6** N.S. iii, Proceedings, 60).

Die Back	*Brunchorstia destruens* Erikss.	Moray (van Vloten, **14**, xliii, 157)

McIntosh's record (**10**, iv, Proceedings, 182) of *Cucurbitaria pithyophila* Fr. killing 'fir' at Inver (Tay) presumably applies to this host.

Borthwick (**7**, xxi, 196) recorded a witches' broom on *Pinus sylvestris*, locality unspecified.

POPULUS spp. (Poplars)

*Leaf Curl (*P. nigra* and *P. balsamifera*)	*Taphrina aurea* (Pers.) Fr.	Forth, Tay, Dee, Moray
*Carpel Deformation (*P. tremula*)	*Taphrina Johansonii* Sadeb.	Tweed, Forth
Rusts (*P. trichocarpus*)	*Melampsora Allii-populina* Kleb.	Solway (Wilson, **7**, xxxi, 422)
	**Melampsora Larici-populina* Kleb.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray (Wilson, **7**, xxxi, 422)

On *Populus candicans*, *P. generosa*, *P. laurifolia*, *P. nigra*, *P. robusta* and *P. trichocarpa*.

	Melampsora Rostrupii Wagner	Forth (Wilson, **7**, xxxi, 423)
	Melampsora Larici-tremulae Kleb.	Forth, Clyde, Argyll, Tay, Dee, Moray (Wilson, **7**, xxxi, 422)

On *Populus alba* and *P. tremula*.

*Die Back	*Polyporus squamosus* (Huds.) Fr.	Forth
*Canker and Die Back	*Cytospora chrysosperma* (Pers.) Fr.	Forth, Clyde
*Leaf Spot	*Marssonina Populi* Magn.	Tweed, Forth, Clyde, Tay

Fomes igniarius (L.) Fr. was recorded 'on poplar trees, banks of Findhorn', Moray by Keith (**1**, ii, 247). *Fomes populinus* Fr. has occurred in Tweed (**11**, xxix, 311) and Clyde (**5**, viii, 171).

PSEUDOTSUGA DOUGLASI (Douglas Fir)

*Leaf Cast	*Rhabdocline Pseudotsugae* Syd.	Tweed
Heart Rot	*Fomes annosus* Fr.	'Fifeshire' (M'Hardy, **14**, xliii, 18)
Brown Rot	*Polyporus Schweinitzii* Fr.	Tay (Murray, **17**, xxx, 56)
*Canker	*Phomopsis Pseudotsugae* Wilson	Tweed, Solway, Clyde, Argyll, Tay Dee, Moray

First recorded in 1896 from Clyde as '*Phoma pithya* Sacc.' by Somerville (**17**, xv, 190).

Grey Mould	*Botrytis Douglasii* Tub.	Tay (Wilson, **3**, vii, 85), Dee (Farquharson, **2**, 1911, 240)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc.? (Wilson & Waldie, **17**, xl, 34)

PYRUS AUCUPARIA (Rowan)		
Rust	*Gymnosporangium Juniperi* Link	Tweed, Solway, Forth, Clyde, Tay, Argyll, Dee, Moray, Ross (Trail, **1**, N.S. iv, 321)
Leaf Spots	*Phyllosticta Sorbi* Westend.	Dee (Trail, **1**, N.S. iv, 280)
	Septoria Sorbi Lasch.	Tay (White, **1**, v, 276), Dee, Ross (Trail, **1**, N.S. iii, 121)
QUERCUS ROBUR (Oak)		
*Mildew	*Microsphaera quercina* (Schw.) Burr.	Solway, Forth, Clyde, Tay, Moray
Leaf Spot	*Taphrina coerulescens* (Dur. & Mont.) Tul.	Tay, Dee (Trail, **10**, ii, 127)
*Leaf Spot	*Sclerotinia Candolleana* (Lév.) Fuckel	Clyde, Tay, Dee, Moray
*Heart Rot	*Polyporus sulphureus* (Bull.) Fr.	Forth, Clyde, Tay
*Brown Oak	*Fistulina hepatica* (Huds.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Moray, Argyll
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde
Polyporus dryadeus (Pers.) Fr. was recorded on living oak in Cadzow Forest, Clyde, by Stevenson (**1**, vi, 37) and from Solway (**1**, N.S. i, 182).		
*Canker	*Phomopsis* sp.	Tay
*Brown Slime Flux	Cause unknown	Tay
ROBINIA PSEUDACACIA		
Mildew	*Erysiphe Polygoni* DC.	Dee (Farquharson, **2**, 1911, 242)
SALIX spp. (Willows)		
Mildew	*Uncinula Salicis* (DC.) Winter	Forth, Moray (Trail, **6**, N.S. iii, 15)
*Black Spot	*Rhytisma salicinum* Pers.	Solway, Clyde, Tay, Dee, Moray, Argyll
*Black Canker	*Physalospora Miyabeana* Fukushi	Forth
*Stem Blister	*Cryptomyces maximus* (Fr.) Rehm.	Moray
*Branch Disease	*Scleroderris fuliginosa* (Pers.) Karst.	Moray
Myxosporium scutellatum (Otth) Petrak, associated.		
*Rusts	*Melampsora* spp.	
Eleven species are recognized by Wilson (**7**, xxxi, 416), whose work should be consulted for details of distribution.		
*White Heart Rot	*Fomes igniarius* (L.) Fr.	Tweed
*Scab and Die Back	*Fusicladium saliciperdum* (All. & Tub.) Tub.	Clyde
Leaf Spot	*Gloeosporium Salicis* Westend.	Solway (**4**, 1909), Forth (**7**, vi, 196, and 273), Clyde (**5**, i, 115 and 140), Moray (**4**, 1912)
Leaf Spot	*Septogloeum salicinum* Sacc.	Clyde (Boyd, **5**, i, 115)
SEQUOIA GIGANTEA		
Cubical Rot	*Coniophora puteana* (Schum.) Karst.	Tay (Macdonald, **24**, xxvi, 83)
TAXUS BACCATA (Yew)		
*Leaf Scorch	*Sphaerulina Taxi* Mass.	Tweed, Forth, Clyde, Tay, Dee
*Leaf Scorch	*Physalospora gregaria* Sacc. var. *foliorum* Sacc.	Forth, Clyde
*Canker	*Physalospora* sp.	Tay
	Anthostomella Taxi Grove, associated with dying yew in Forth and Clyde is not regarded as a parasite (Callen, **3**, xxii, 94).	
Ganoderma lucidum (Leyss.) Karst., which is extremely rare in Scotland, has been recorded on old yews on Inch Lonaig, Loch Lomond, Clyde (**5**, i, 138).		
THUJA spp.		
*Leaf Spot	*Keithia thujina* Durand	Solway, Clyde, Argyll
An unidentified species of *Pestalotia* is said by Laing (**14**, xliii, 48) to be parasitic on *Thuja*.		

TSUGA ALBERTIANA

Canker	*Phomopsis Pseudotsugae* Wilson	'Fifeshire' (Wilson, **17**, xxxv, 73)

TSUGA CANADENSIS

Leaf Spot	*Keithia Tsugae* (Farl.) Durand	Tweed (Wilson, **14**, li, 46)

ULMUS spp. (Elms)

*Dutch Elm	*Ceratostomella Ulmi* (Schwartz) Buism.	Tweed

An isolated occurrence on a felled tree.

Leaf Spot	*Dothidella Ulmi* Wint.	Tweed, Solway, Clyde, Tay

Asteroma Ulmi Klotsch has been recorded from Forth, Clyde, Dee and Moray (Trail, **1**, 3rd Ser. i, 32; **1**, N.S. iv, 65; **1**, N.S. iii, 125) and *Piggotia astroidea* B. & Br. from Tweed, Forth and Tay (Trail, **1**, N.S. iii, 235).

Heart Rot	*Fomes connatus* Fr.	Moray (Keith, **1**, ii, 247)

Fomes ulmarius (Sow.) Fr. is on record on elm in Forth (**9**, i, 296), Tay (**1**, v, 271) and Dee (**13**, p. 138), as is *Polyporus squamosus* (Huds.) Fr. on wych elm in Tweed (**11**, x, 243).

Leaf Spot	*Septogloeum Ulmi* (Fr.) Died.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray (Trail, **1**, N.S. iii, 232)
Brown Slime Flux	*Fusarium* sp. and *Oospora lactis* (Fresen.) Sacc., associated	Dee (Ogilvie, **3**, ix, 171)

MISCELLANEOUS

HOP

*Downy Mildew	*Pseudoperonospora Humuli* (Miyabe & Tak.) G. W. Wilson	Dee
*Mildew	*Sphaerotheca Humuli* (DC.) Burr.	Solway, Clyde, Tay, Moray

FLAX

*Seedling Blight	*Colletotrichum Lini* (Westerd.) Toch.	
*Browning	*Polyspora Lini* Laff	
*Damping Off	*Botrytis cinerea* Pers. f. *Lini* van Beyma Thoe Kingma	

All common on Scotch-grown flax seed received at the Seed Testing Station.
Rust (*Melampsora Lini* Desm.) is prevalent on *Linum catharticum* (Wilson, **7**, xxxi, 423), but is so far not recorded on cultivated flax.

TIMBER

*Dry Rot	*Merulius lachrymans* (Wulf) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
Dry Rot	*Lenzites saepiaria* (Wulf) Fr.	Forth (Wilson, **7**, xxxi, 476)
*Dry Rot	*Coniophora puteana* (Schum.) Karst.	Tweed, Forth, Clyde, Tay, Moray
Dry Rot	*Lentinus lepideus* Fr. and *L. adhaerens* (A. & S.) Fr.	Forth (Wilson, **7**, xxxi, 477), Clyde (**6**, N.S. iv, 394)

ROTTING OF JUTE BAGS

*Rot	*Merulius lachrymans* (Wulf) Fr.	Tay

ENTOMOGENOUS FUNGI

**Empusa Muscae* Cohn	On house-flies	Solway, Forth, Tay
Empusa Aulicae Reichhardt	On caterpillars	Tay (Petch, **3**, xvii, 170)
Empusa Fresenii Nowak.	On aphides	Moray, Sutherland (Cotton, **3**, vi, 201)
**Entomophthora Lampyridarum* Thaxter	On heather beetle	Forth (Det. T. Petch)
**Entomophthora Aphidis* Hoffm.	On aphides	Forth, Moray (Det. T. Petch)
**Cordyceps militaris* (L.) Link	On pupae	Solway, Forth, Clyde, Tay, Moray
**Cordyceps Forquignoni* Quélet	On a fly	Clyde (Det. T. Petch)

? *Cordyceps sphecocephala* (Kl.) Cooke	On a wasp	Moray (Petch, **3**, xvii, 173, citing Keith, **1**, ii, 365)
**Cephalosporium aphidicola* Petch	On strawberry aphis	Clyde (Det. T. Petch)
Metarrhizium Anisopliae (Metsch.) Sor.	On *Sitones* larvae	Moray (Petch, **3**, xvii, 174)
Beauveria Bassiana (Bals.) Vuill.	On *Sitones lineatus*	Moray (Petch, **3**, xvii, 174)
Cladosporium Aphidis Thüm.	On aphides	Moray (Cotton, **3**, vi, 203)
**Isaria farinosa* Fr.	On pupae	Solway, Forth, Clyde, Tay, Moray
'*Isaria arachnophila*' Ditm.	On spiders	Forth (Trail, **1**, 3rd Ser. i, 33), Clyde (Boyd, **5**, iv, 17), Tay (White, **1**, v, 325)
Akanthomyces aculeata Lebert	On moths	Solway (Petch, **3**, xvii, 176)
Hirsutella Eleutheratorum (Nees) Petch	On a beetle	Dee (Trail, **1**, N.S., iii, 172)

For Scottish Laboulbeniales see Bisby and Mason (**3**, xxiv, 131).

REFERENCES

The references in the body of the text are to be interpreted as follows: the first number in Clarendon type refers to the item in the list below; the second number in roman numerals, gives the volume, and the third number, in arabics, the page. Items 2 and 4 below are issued without volume numbers and in these the date of the volume replaces the roman numerals.

(**1**) *Scottish Naturalist.*
(**2**) *Annals of Scottish Natural History.*
(**3**) *Transactions British Mycological Society.*
(**4**) *Annual Reports Scottish Cryptogamic Society.*
(**5**) *Glasgow Naturalist.*
(**6**) *Transactions and Proceedings Natural History Society of Glasgow.*
(**7**) *Transactions Botanical Society of Edinburgh.*
(**8**) *Journal of Botany.*
(**9**) *Transactions Edinburgh Field Naturalists Society.*
(**10**) *Transactions and Proceedings Perthshire Society Natural Science.*
(**11**) *History Berwickshire Naturalists Society.*
(**12**) *Transactions Dumfries and Galloway Natural History Society.*
(**13**) Stevenson, J., *Mycologia Scotica.* Edinburgh (1879).
(**14**) *Scottish Forestry Journal.*
(**15**) Sampson, K. & Western, J. H., *Diseases of British Grasses and Legumes.* Cambridge (1941).
(**16**) Grove, W. B., *British Stem and Leaf Fungi.* 2 vols. Cambridge (1935, 1937).
(**17**) *Transactions Royal Scottish Arboricultural Society.*
(**18**) *Gardeners' Chronicle.*
(**19**) *Scottish Journal of Agriculture.*
(**20**) *Arb. aus der Biol. Reich anst. f. Land- u. Forstw.*
(**21**) *Nature.*
(**22**) *Annals of Botany.*
(**23**) *West of Scotland Agricultural College Research Bulletins.*
(**24**) *Annals of Applied Biology.*
(**25**) *Journal Board of Agriculture, London.*
(**26**) *Annual Reports Cheshunt Experimental and Research Station.*
(**27**) Wormald, H., *Diseases of Fruit and Hops.* London (1939).
(**28**) *Notes from Royal Botanic Garden, Edinburgh.*
(**29**) *Annual Reports Department of Plant Pathology, Seale-Hayne Agricultural College.*
(**30**) *Ministry of Agriculture and Fisheries Bulletins.*

(*Accepted for publication* 22 *December* 1941)

THE OCCURRENCE IN ARTIFICIAL CULTURE OF TREMELLOID OUTGROWTHS ON THE PILEI OF *COPRINUS EPHEMERUS*

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(With Plate XI)

During 1937–8, while investigating the physiology of some Basidiomycetes at the Imperial College of Science and Technology, I obtained isolations of various species of *Coprinus* which formed fruit-bodies on incubated horse-dung, and one of these fungi was selected for culturing on artificial media. Its identity on the natural habitat was not determined but the fruit-bodies bore a close resemblance to those of *C. ephemerus*.

In the course of this work some of the fruit-bodies produced in artificial culture bore tremelloid excrescences. No critical observations were made at the time on their structure, but an account of the circumstances of their production may assist in answering some of the questions raised by previous observers of similar structures on other agarics.

All previous records of such structures on fungi are of specimens growing under natural conditions. The various records which have been made are well summarized by Buller (1924) and Ramsbottom (1933).

The structures were first regarded as parasitic and given the name of *Tremella mycetophila*. Later, this theory was discarded and they were then regarded as abnormal outgrowths of the fruit-body on which they were found. They were most commonly found on the pileus and stipe of *Collybia dryophila* but occasionally on *C. butyracea*, *Laccaria laccata* and *Collybia velutipes*. All observers describe a hymenium covering each outgrowth, bearing basidia with basidiospores; some record the presence of numerous minute catenate conidia within the outgrowths.

Ramsbottom (1933) describes three specimens of *Collybia dryophila* (found on an autumn foray in 1932) bearing tremelloid outgrowths on the pileus and stipe. No conidia were seen in sections of these specimens.

There have been many attempts to explain the production of such outgrowths on agarics. Buller records that one observer, Burt,

believed them to be induced by protracted wet weather during the period of development of the fruit-body. Buller tentatively suggested that the tendency to produce these outgrowths may be inherited, and Ramsbottom states that Ulbrich lists such malformations as mutations. Ramsbottom concluded that the structures he described were overgrowths from the pileus and stipe, and states that what was apparently a dipterous insect was occasionally seen in a cavity of the overgrowth. He suggested that renewed growth of hyphae at the surface of the pileus and stipe had occurred after normal growth had ceased.

During the course of my own investigation on the physiology of *Coprinus ephemerus* it was desired to determine whether variations in the air conditions under which the mycelium was growing would cause variations in the number or size of fruit-bodies produced. Thirty-three subcultures of the fungus, which had originally been grown from a single hyphal tip, were made in Petri dishes. These cultures were grown on an artificial medium consisting of glucose 0·4 g., sodium nitrate 1·4 g., potassium mono-hydrogen phosphate 0·8 g., agar 20 g., water 1 l. Eighteen of the cultures were placed in an apparatus which had been designed so that sterilized air could be passed over the surfaces of the cultures.

Fifteen control cultures in closed Petri dishes were stood in three piles on the laboratory bench beside the apparatus. All the cultures were exposed to normal daylight about four feet from a window.

After eighteen days, with an unstandardized stream of air passing through the apparatus, it was seen that the two sets of cultures were fruiting simultaneously and that the aeration did not hasten fruiting. However, about three-quarters of the fruit-bodies inside the chamber bore tremelloid excrescences on their caps, whereas those in the unaerated Petri dishes were quite normal. Some of the fruit-bodies produced in the aerated dishes had begun to deliquesce and the outgrowths were deliquescing at the same time.

Each outgrowth consisted of a much lobed and convoluted mass of white tissue covering the top of the cap and of about the same diameter as the unexpanded pileus. No outgrowths were seen which were distorted or enlarged in proportion to the cap, and each outgrowth appeared to be a perfectly proportioned and integral part of the cap on which it was growing.

As the significance of the formation of these outgrowths was not realized at the time no material was preserved for careful sectioning. A few hand sections were made, however, of abnormal fruit-bodies in various stages of development and some of these are illustrated in Pl. XI. These showed that each outgrowth developed at the same time as the pileus on which it was growing and was not formed after normal growth had ceased. When mature, each outgrowth was covered with a hymenium with basidia bearing spores indistinguish-

able from those on the gills. Each basidium was a single undivided cell. The hymenium on the outgrowth was very delicate and rapidly disintegrated on contact with any preservative so that all attempts to preserve or mount a portion of it failed. No conidia were observed within the tremelloid outgrowths.

Cultures were made by placing portions of the outgrowths on plain agar in test tubes. Mycelium readily grew from each portion and the cultures so formed eventually produced normal fruit-bodies.

The fact that the fungus was growing in pure culture and that subcultures from the outgrowths produced normal fruit-bodies precludes any possibility that the outgrowths were parasitic. They were obviously produced from the pilei on which they were growing. They were not the result of a mutation since no outgrowths were formed on similar unaerated cultures, and subcultures of the outgrowths formed normal fruit-bodies. They did not arise as a result of insect damage. They were produced, however, by an external stimulus, namely the exposure of the cultures to a stream of air. The humidity, temperature and pressure of the air were unknown but it is very probable that the air in the apparatus was drier and cooler than that in the closed Petri dishes.

The tremelloid outgrowths found in nature may be produced by some stimulus similar to that applied in this experiment. It is significant that outgrowths were present even on the youngest fruit-bodies and it is possible that they will not be found unless the mycelium from which the fruit-body is to grow is exposed and stimulated so that development of the outgrowth can start at the inception of development of the fruit-body and continue simultaneously with it. It is conceivable that once the normal fruit-body has grown beyond a certain stage the stimulation will have no effect upon it. These points, as also the precise conditions under which these outgrowths are formed, remain to be investigated.

The fact that under certain conditions these outgrowths are formed reveals, as is emphasized by Buller, that the fruit-bodies of some agarics may vary greatly in form in response to external stimuli whereas they were previously thought to be incapable of variation in structure beyond certain narrow limits.

Summary

During an experiment in which a stream of sterile air was passed over pure cultures of a species of *Coprinus* (probably *C. ephemerus*) fruit-bodies were formed bearing tremelloid outgrowths in their pilei. Similar cultures in closed Petri dishes developed normal fruit-bodies.

The production of such outgrowths under these circumstances

shows that they were not parasitic or the result of a mutation but were induced to develop by the condition of the air under which the cultures were growing.

My thanks are due to Prof. W. Brown for facilities and help in carrying out these experiments and to Dr L. Hawker for her interest in the work.

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EXPLANATION OF PLATE XI

Fig. 1. Mature fruit-body of *Coprinus ephemerus* bearing an outgrowth on the cap. ×10.

Fig. 2. Longitudinal section of a half-grown normal fruit-body. ×30.

Fig. 3. Longitudinal section of a very young fruit-body bearing an outgrowth. Gill cavities just visible. ×30.

Fig. 4. Longitudinal section of a half-grown fruit-body bearing an outgrowth. ×30.

(*Accepted for publication* 8 *January* 1942)

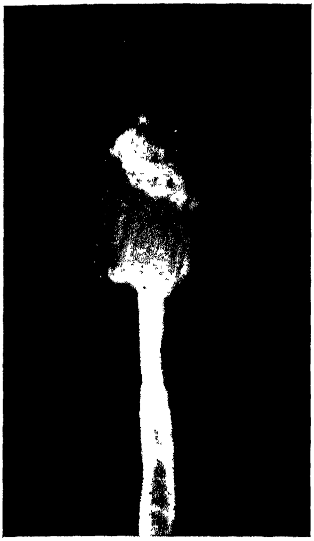

Fig. 1

Fig. 2

Fig. 3

Fig. 4

ON THE GENERIC NAME OF THE GRAM-POSITIVE BACTERIAL PLANT PATHOGENS

By W. J. DOWSON

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Although Gram's method of staining bacteria has become a routine practice in identification it is only within the last few years that bacteriologists have come to realize its probable significance arrived at by investigations of the mechanism of the differential staining. Henrici (1934), Kluyver and van Niel (1936) and others are of the opinion that the two classes into which bacteria and certain other organisms are so sharply divided by Gram's method of staining is in reality a reflexion of a fundamental difference between the proteins of the two groups, which are therefore considered to be not closely related. Thus the lower algae and fungi are Gram-negative, as are also the Protozoa, while the Actinomycetes, Mycobacteriaceae and Bacillaceae are Gram-positive. In applying the conception to genera it follows that a genus cannot include both Gram-positive and Gram-negative organisms.

Among the bacteria causing plant diseases the great majority are Gram-negative (Dowson, 1941), but there are six well-described species which are Gram-positive, and for these some genus other than those used for the Gram-negative forms must be sought. Bergey (1939) places them all in his genus *Phytomonas*: they are, *P. fascians* Tilford, *P. flaccumfaciens* (Hedges) Bergey, *P. insidiosa* (McCulloch) Bergey, *P. michiganensis* (Erw. Smith) Bergey, *P. sepedonica* (Spieckermann) Magrou and *P. Rathayi* (Erw. Smith) Bergey. As, however, the genus *Phytomonas* consists of Gram-negative motile green-fluorescent and yellow bacteria together with Gram-positive non-motile forms it is not acceptable to most bacteriologists, and has, moreover, been shown to be invalid (Elliott, 1937; Dowson, 1939). There has long been a genus *Corynebacterium* Lehmann & Neumann for certain bacteria which is defined by Bergey (1939, p. 791) as follows: '*Corynebacterium* Lehmann & Neumann, 1896. Slender, often slightly curved, rods with tendency to club and pointed forms, with branching forms in old cultures. Barred uneven staining. Not acid fast. Gram positive. Non-motile. Usually aerobic. No endospores. Some pathogenic species produce a powerful exotoxin. Characteristic snapping motion is exhibited when cells divide. The type species is *Corynebacterium diphtheriae* (Flügge) Lehmann & Neumann.' Jensen (1933, 1934) studied these bacteria in New South Wales and

constructed a tentative key for identifying them which is reproduced by Bergey (1939, p. 806). Jensen's description of the genus is: 'Non-motile bacteria without endospore formation, Gram-positive, not acid fast, generally rod-shaped but with a marked tendency to formation of irregular, club- or wedge-shaped, sometimes branching cells of a more varying size and shape than is usually found among the *Eubacteriales*, and multiplying by a characteristic "snapping" division of the cells, which causes the bacteria in microscopical preparations to appear in V- or III-like arrangements, or irregular groups sometimes compared to Chinese letters.' Among the species Jensen found to be abundant in certain grass soils were two closely resembling the pathogenic species *Phytomonas insidiosa* and *P. michiganensis*, authentic cultures of which were compared with the New South Wales saprophytes and as they proved to be identical, Jensen recommended the names *Corynebacterium insidiosum* and *C. michiganense* for them. Of the former Jensen (1934, p. 41) says: '*Aplanobacter insidiosum* McCulloch (McCulloch & Jones, 1926)...their careful description and instructive microphotographs leave no doubt that the organism was really a *Corynebacterium*'; and of the latter (1934, p. 47), 'this species has been carefully examined by Stapp (1930), whose fine microphotographs and generally good description leave no doubt that it is really a *Corynebacterium*. The same is evidently true of the closely related *Bacterium sepedonicum* (Stapp, 1930) and *Aplanobacter rathayi* (Smith, 1914).'

Both Hedges (1926) and Burkholder (1930) describe *Phytomonas flaccumfaciens* as having one polar flagellum, but Adam and Pugsley (1934) describe the organism as being non-motile as are the other five species. Burkholder (1930, p. 34) states that 'the longest rods often show a slight curve, and a few of the cells appear to be larger at one end than at the other', which is characteristic of the genus *Corynebacterium*. That *Phytomonas fascians* is also a species of *Corynebacterium* is evident from the descriptions of the organism given by the two investigators who have studied it in detail. Tilford (1936) states that, grown on potato dextrose agar U and V shapes are found, and that in older cultures 1–3 round bodies which are not spores, occur in the cells: and Lacey (1936) describes the growth as being filamentous in old cultures, frequently in groups forming Y's, W's, star-shapes and involution forms, and in old cultures intracellular bodies, not spores, are frequent. The grouping, U's, V's, Y's and W's are characteristic of the post-fission movements of *Corynebacterium*, and the intracellular bodies are due to irregular staining of the contents: both are recorded in most systems of classification.

In view of the above facts it is recommended that the names of the Gram-positive plant pathogens be as follows:

1. *Corynebacterium sepedonicum* (Spieckermann) n.comb., the cause

of bacterial ring rot of potatoes, first described by Spieckermann (1913). Not recorded in Britain.

2. *Corynebacterium Rathayi* (Smith) n.comb., the cause of yellow slime disease of cocksfoot, first described by E. F. Smith (1914). Occurs in Britain.

3. *Corynebacterium michiganense* (Smith) Jensen, the cause of the Grand Rapids disease or bacterial canker of tomatoes, first described by E. F. Smith (1914). Not recorded for Britain.

4. *Corynebacterium insidiosum* (McCulloch) Jensen, the cause of bacterial wilt of lucerne, first described by McCulloch (1925). Not recorded for Britain.

5. *Corynebacterium flaccumfaciens* (Hedges) n.comb., the cause of a systemic disease of beans (*Phaseolus*), first described and named by Hedges (1922) and more fully described by her in 1926. Not recorded for Britain.

6. *Corynebacterium fascians* (Tilf.) n.comb., the cause of fasciation of sweet peas and strawberry and of leafy galls on chrysanthemum, carnation, *Schizanthus* and other plants, described simultaneously by Tilford (1936) in America and by Lacey (1936) in England who later (1939) called the organism *Bacterium fascians*.

The writer is indebted to W. H. Burkholder of Cornell University for drawing his attention to Jensen's papers in the first place.

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(*Accepted for publication* 12 *January* 1942)

SOME WATER MOULDS OF THE HOGSMILL RIVER COLLECTED FROM 1937 TO 1939

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(With 1 Text-figure)

The Hogsmill river is a minor tributary of the Thames, seven or eight miles long, rising in the High Street, Ewell (Surrey), and entering the main river at Kingston. Powerful springs issuing from the north side of the North Downs where Thanet sand meets the Upper Chalk come to the surface in four lakes alongside the village street and form the source of the river (Dewey & Bromhead, 1921). Similar springs in the neighbourhood give rise to most of the tributaries. The Hogsmill river though once famous for trout has not been a completely rural stream for some centuries. From 1589 to 1613 there were twelve gunpowder mills on its banks. These have been replaced by two flour mills and a brick, tile and pottery works. The effluents from these and from four sewage works, together with the drainage from 26·7 sq. miles (half of which is chalk land) augment the basic flow of spring water.

The average annual rainfall at Ewell is 26·5 in. and at Kingston-on-Thames 21·5 in. The river is usually fairly shallow (4–7 in. at the bank and 10–13 in. in midstream) and yet maintains a good flow throughout the year with a maximum in spring (usually in March but may be in February or as late as May), and a minimum, averaging about a quarter of the maximum flow at the source, in November. This seasonal variation in flow is due to the rise and fall of the springs. Continuous heavy rain causes a rise of a foot or more and occasionally in winter the river overflows its banks. There are no official records of it ever having dried up, possibly because of the constancy of the springs and sewage effluents. The normal rate of flow in midstream is 0·8 mile per hour.

The water is constantly alkaline and the *p*H shows an annual variation from 7·2 in winter and early spring to 8·0 in summer. The surface water is slightly more alkaline than the bottom water especially in dry weather. These records are comparable with those of Rice (1938) for the Thames. He attributed the annual fluctuation to the removal of carbon dioxide by green plants in summer and to the large amount of decaying matter in autumn. Chemical analyses made by the Thames Conservancy each year in spring show that between the source and the outflow there is a considerable increase in

sodium chloride, organic matter and nitrogen, both organic and inorganic, caused by the effluents. The hardness at Ewell is nineteen. Temperature, sunshine and other records were not made, but Rice (1938) gives full details for the neighbouring reach of the Thames, and reference to these would give a good idea of the conditions in the Hogsmill valley. During the two years when collections of water moulds were made, the outstanding features of the weather were the very dry spring of 1938 (total rain February–April only 0·68 in.) and the severe cold in December both in 1937 and in 1938. The river, however, was not frozen, nor is it known to have been frozen over for many years.

The region where the water moulds were collected lies in one of the few remaining rural parts of the river about midway along its course. Here it flows in a north-easterly direction in what is considered to be the abandoned valley of the river Mole. It is a wide alluvial valley in a region of London clay. The stream is about 17·5 ft. wide with banks 2·5 ft. high and a bed of soft black mud 5–6 in. deep. The banks are bordered by meadows, and the left (north) bank is overhung by trees—hawthorn, elder and ash (*Crataegus Oxyacantha*, *Sambucus nigra*, and *Fraxinus excelsior*). Once a year the Surrey County Council has the river cleared of vegetation and the banks trimmed. Consequently there are no large aquatic plants and few algae. This and the absence of trees to the south means that the river is fully exposed to the sun.

Methods of collection

The usual methods of setting bait were employed, the containers used being galvanized tins with holes punctured in the bottom and sides to permit the passage of water through the tin. At first various fruits and twigs were used as substrata either in the river or for fresh inoculations in the laboratory. Eventually tomatoes were used almost exclusively as these proved most satisfactory in rapidity and variety of infection and in the facility of examination provided by the thin transparent easily removable skin. Moreover, it was found that all species originally found on other bait grew well on tomatoes. In the laboratory the material was kept in glass jars in tap water (*p*H 8·0) which was frequently changed. It was thought to be unnecessary to attempt to get pure cultures except for species of *Pythium* and *Phytophthora* (including *Pythiomorpha*) which were transferred to agar cultures for identification. Cultures containing single species were obtained by placing a pustule or zoospores with fresh bait.

In the winter the first pustules appeared on tomatoes that had been in the river ten days. In July and September 1938 none were seen until after fourteen to seventeen days, and in May 1938 there were none until after twenty-three days' immersion.

Species encountered and their occurrence

Chytridiaceae

One chytrid, closely related to *Pleolpidium inflatum* Butler, parasitic in a species of *Phytophthora* has been described in detail (Waterhouse, 1940). No others were found during the two years, but in November 1941 *Pleolpidium Blastocladiae* von Minden appeared as a parasite in both *Blastocladia Pringsheimii* and *B. gracilis*. Numerous typical spiny resting spores were formed after two weeks.

Blastocladiaceae

Blastocladia Pringsheimii Reinsch.

As is usual, this species was the most abundant and constantly appearing of all the water moulds, apparently inactive in the stream only in August 1938 and 1939. This may have been due to the very low summer level of the river in both years, and perhaps the fungus may continue its activity unabated during a wet summer. It appeared also in its usual wide variety of form. Two types of thallus were encountered more frequently, (1) a globose form and (2) a branched form, corresponding to types A and C of Lloyd (1938). Resistant sporangia appeared intermittently, sometimes in profusion. They were never found on bait which had been in the river for a month during the autumn, winter and spring, until this bait had been kept in the laboratory for a month or two. In May, June and July, however, resistant sporangia were found on the bait when taken from the river. Some of the resistant sporangia were spherical, some shortly clavate, and others elongated and looking like zoosporangia converted into resistant sporangia.

Some of the resistant sporangia were germinated. Tomato skins which had borne plants with numerous sporangia in March 1938 were kept in water until July. They were then allowed to dry slowly from the end of July until the end of September. A day after flooding with tap water very many of the resistant sporangia discharged zoospores. Some of these settled down and germinated by means of a tube; others put with fresh tomatoes gave young plants (not visible to the naked eye) in twenty-four hours.

Blastocladia gracilis Kanouse.

In the early part of the year this species was sometimes more abundant than *B. Pringsheimii* but less so in the other months, and disappeared from June or July until October. Its most striking feature is the rapid and prolific production of resistant sporangia which appear within fourteen days from the time of inoculation. They are more constant in shape than those of *B. Pringsheimii*, being oval with a truncate

base and having a more transparent wall with less conspicuous pits (Fig. 1). In Denmark, Lund (1934) found that *B. gracilis* occurred all the year round but only in waters which were neutral or constantly alkaline. As he examined only lakes, ponds and pools, it is interesting to find this species occurring in the constantly alkaline Hogsmill river, thus extending Lund's observation to yet another type of water.

The resistant sporangia of this species were germinated in the same way as those of *B. Pringsheimii*. The fate of the zoospores thus produced was not followed, but young plants soon appeared on tomatoes put with the germinating spores.

This is the first record of *Blastocladia gracilis* in the British Isles:

Whole plant with rhizoids	$1500\,\mu$.
Zoosporangia average size	$78 \times 27{\cdot}5\,\mu$.
Resistant sporangia	$45–55 \times 30–38\,\mu$.

Blastocladia ramosa Thaxter and *B. incrassata* Indoh

Occasional plants were found in November, December and January each year (Fig. 1). They were of the same size ($600\,\mu$) as those described originally by Thaxter (1896). A few plants had small zoosporangia comparable with Thaxter's specimens, but the zoosporangia and resistant sporangia of the majority of the plants were larger and corresponded in size with those of a specimen found by Sparrow (1936) in the vicinity of Cambridge, England. Indoh (1940) has suggested that Sparrow's plant belonged to a different species and has renamed it *B. incrassata*. As the size and form of the thallus is so variable among individual plants of the same species in this genus it may well be that the two forms are varieties of *B. ramosa*. They are similar in habit, branching and shape of sporangia.

Whole plant with rhizoids	$600\,\mu$.
Trunk	$250 \times 35–80\,\mu$.
Zoosporangia	$65–85 \times 20–24{\cdot}5\,\mu$.
Resistant sporangia	$34–38 \times 20–28\,\mu$.

Blastocladia glomerata Sparrow

A number of plants referable to this species were found on a tomato taken from the river in July 1939. The plants were small compared with other species of *Blastocladia* (Fig. 1). The zoosporangia were very variable in size, but on the whole rather short and broad. Occasional resistant sporangia were found.

Trunk	$90–130\,\mu$ broad.
Zoosporangia	$60–120 \times 26–58\,\mu$.
Resistant sporangia, average size	$47 \times 40\,\mu$.

A few pustules composed of smaller plants than the above appeared on tomatoes in the river in September 1939. The zoosporangia were

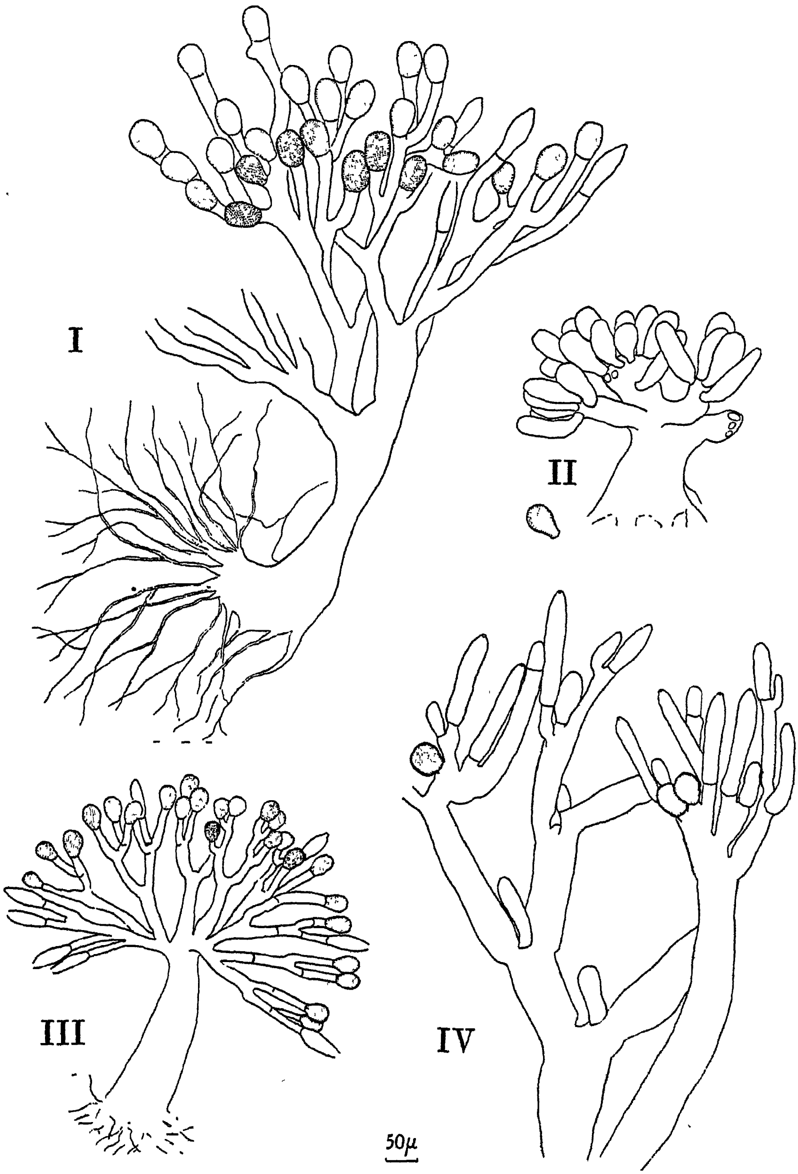

Fig. 1. Four species of *Blastocladia* from the Hogsmill River. I, *B. gracilis*. II, *B. glomerata*. III, *B. ramosa*. IV, *Blastocladia*? (All drawn to the same scale with camera lucida.)

shorter (average 60μ) and narrower (17–20μ). In longitudinal section their shape was like a foot sole. There was no papilla and no region taking a deeper stain in cotton blue which could be recognized as a papilla region. After the discharge of zoospores the apical part of the wall protruded as a short neck. The basal trunk of the thallus was short and then branched once or twice dichotomously, bearing three or four sporangia at the end of each branch. A few young resistant sporangia were found and they were similar to those of *B. glomerata*. This is probably a variety of that species.

Other species of *Blastocladia*:

(1) A species which could not be identified is shown in Fig. 1, IV. Plants were found once on a single tomato. They most nearly resembled the branched forms of *B. Pringsheimii* but differed from them in that the zoosporangia were borne singly on the ends of the branches, growth being continued sympodially.

(2) One or two plants which were thought to represent the species *B. truncata* Sparrow appeared in July 1938 and in July and August 1939. Both zoosporangia and resistant sporangia were present.

(3) A few globose plants resembling those described for the species *B. globosa* Kanouse were found after germination of resistant sporangia on dried twigs. The only feature which seems to distinguish *B. globosa* from the extreme globose forms of *B. Pringsheimii* is the brittle nature of the thallus. As this feature was not noticeable in the specimens examined it was presumed they were forms of *B. Pringsheimii*.

Gonapodyaceae

Gonapodya prolifera (Cornu) Fischer

This species was extraordinarily sporadic in its appearances. It would be found covering a tomato after long immersion and then suddenly die out even though fresh bait were put in to obtain a succession of growth. It suggests that the fungus requires a substratum at a certain stage of waterlogging and decay, and that fresh material is not suitable. Apple slices were tried but other hyphal Phycomycetes gained a foothold more readily and soon overran the *Gonapodya*. The best growth appeared during a hot spell in July 1938, which does not coincide with the findings of Sparrow (1933) who states that *Gonapodya* grows best at very low temperatures (8° C.). Other appearances were in May, June, July and October 1938 and May 1939. No reproductive organs other than zoosporangia were seen. These gave zoospores freely and the hyphae proliferated new sporangia several times within the original sporangium; the new ones never protruded beyond the previous one.

Sporangia 115–174 × 22–31·5μ, average 146 × 27μ.

Leptomitaceae

Rhipidium continuum Cornu (= *Rhipidium europaeum* von Minden)

The life history of this species was followed during the winter months when it appeared most abundantly. It was found to correspond closely with the description and figures of Behrens (1931). It was not encountered all the year round as some investigators found (Lund, 1934; Sparrow, 1936), but attacked bait from November to February (or March) only. It infected tomatoes rapidly, pustules appearing in nine to twelve days, and on two occasions in four and seven days. It occurred most abundantly after a very cold spell in December 1938. Oospores were frequent and formed after four and a half to seven weeks, the usual time being five weeks. This is longer than the time noted by Lund (1934) who obtained them after twenty-three days. The thallus was always of the compact plateau type bearing sporangia and oospores round the edge, suggestive of the variety *compactum* (Forbes, 1935). The variety with erect elongated hyphal branches bearing reproductive organs was not found. Attempts to germinate the oospores were unsuccessful although various coaxing methods were tried, viz. by storing in agar (Blackwell, 1937), both in a refrigerator (temp. 34° F.) and out of doors; by alternately drying and wetting and by treating with potassium permanganate (McKay, 1937) and Petri solutions. Some of the spores showed a gradual reduction of the thick wall to quite a thin layer, and the dispersal of the reserve food bodies accompanied by the extension of the protoplasm to fill the spore. These changes must have been a prelude to germination but none was observed. The noticeable increase of plants of *Rhipidium continuum* after a severe cold spell suggests that they originated from oospores caused to germinate by the cold. It is possible that treatment by freezing may induce germination under laboratory conditions.

Sporangia $41–78 \times 18{\cdot}5–22\,\mu$, average $60 \times 21\,\mu$.
Oospores $27–37\,\mu$ diam.

Rhipidium americanum Thaxter

No sexual organs of this species were seen, although occasional spherical thick-walled spores were found, without, however, a definite antheridium. It was so different from *R. continuum*, even when growing on the same tomato, that it was taken to be *R. americanum* which it resembled very closely. It was not so abundant as *R. continuum*, and during the winter 1937–8 it was found only in January on twigs. During the following winter it appeared occasionally from November to February on bait in the river. It infected tomatoes rapidly, pustules appearing in four days.

Sporangia $50–80 \times 26–34\,\mu$, average $65 \times 30\,\mu$.

Saprolegniaceae

Species of *Saprolegnia* and *Achlya* occurred frequently on suitable bait, but it was decided not to include identification of these in the present investigation.

Pythiaceae

The genus *Phytophthora* (including *Pythiomorpha*)

Hyphal forms were frequently encountered which answered to the descriptions of species of *Pythiomorpha*. There were two types: A, with small sporangia (average size $39 \times 20\mu$) corresponding to *P. gonapodyides* Petersen; B, with larger sporangia (average size $54 \times 36 \cdot 5\mu$), and wider hyphae.

A was found thirteen times on old fruits which had been used as bait in the river during the winter months (October–February). In January 1938 it was found heavily parasitized by a chytrid closely related to *Pleolpidium inflatum* Butler.

B was encountered seven times in November, December and January, and once in May.

Agar cultures (bean, oat, cornmeal and malt) of both forms were made. A good growth was obtained on all four media, the aerial mycelium being especially fluffy on bean and oat. These cultures produced no reproductive organs except spherical swellings resembling chlamydospores, and in one culture a few misshapen sporangia. When portions of agar cultures were transferred to distilled water or Petri's mineral solution, abundant obpyriform, non-papillate sporangia were quickly produced. Secondary sporangia developed either by proliferation through an empty sporangium or by sympodial growth from below. The tendency to sympodial growth was more pronounced in portions floating at or near the surface of the water, whereas proliferation took place more on portions 2–3 cm. below the surface. This phenomenon has been noticed by other investigators and has been attributed to the fact that at the surface the more abundant air supply contributes to more rapid growth, and branching occurs before the sporangia are ready to dehisce or because they are inhibited from doing so by insufficient water supply. Repetitional emergence of zoospores was seen once. Oospores associated with the *Pythiomorpha* type of sporangium were found only once, and these were under the skin of a grape taken from the stream in December 1937.

These forms A and B were indistinguishable from species of *Phytophthora* belonging to the group which is characterized by its obpyriform, non-papillate sporangia, showing proliferation through empty sporangia, and producing reproductive organs sparsely or rarely (except chlamydospores) on solid media. The species of *Phytophthora*

included in this group are: *P. cambivora*, *P. Cinnamomii*, *P. cryptogea*, *P. Drechsleri*, *P. erythroseptica*, *P. Fragariae*, *P. megasperma*, *P. Porri* and *P. Richardiae*.

Form B most nearly resembled *P. cambivora* and A resembled *P. cryptogea*. The invalidity of the genus *Pythiomorpha* has been recently shown (Blackwell, Waterhouse & Thompson, 1941), and these forms are now referred to the genus *Phytophthora*.

The genus *Pythium*

A species of *Pythium* with large spherical sporangia (diameter 22–29μ) made its appearance in most months on bait which had become old and decayed. It was the only fungus recorded in the stream in August 1938. The sporangia were abundant and always spherical with a short lateral discharge tube. If they did not give zoospores the sporangia persisted for months on the bait and finally germinated by hyphae if given fresh media. No sexual organs were obtained either on the bait or in cultures of agar, carrot slices and hemp seed, and it has therefore not been possible to identify this species.

The genus *Pythiogeton*

A *Pythium*-like fungus with oval asymmetrical or spherical sporangia on very thin hyphae was encountered occasionally (once in abundance in July 1938), but the discharge of zoospores was not witnessed. It is referred temporarily to this genus. The sporangia were usually terminal, but occasional subterminal ones were observed. It was very probably *Pythiogeton uniforme* Lund.

Conclusions

Previous recordings of the occurrence of water moulds have been made for ponds, lakes, ditches and small streams. No rivers have been investigated in detail.

In the Hogsmill river most of the moulds have a seasonal rhythm, appearing in September or October, rising to a maximum in December, January and February, and disappearing in summer. One species of *Pythium* is the only fungus which has appeared in all months. On the contrary, in permanent ponds and lakes many moulds, though declining in activity in summer, are still to be found on bait all the year round. The autumnal onset of renewed growth is correlated with the increased rainfall (and therefore flood water), the abundance of suitable substrata (falling fruits and twigs), the declining temperature, and possibly the change in hydrogen-ion concentration. The disappearance in summer is most likely due to rise in temperature, falling water-level, and decrease in hydrogen-ion concentration. The competition with algae in summer is not apparent in the reach of the river studied because of the annual clearance of the river. As the river does

not dry up, drought is not a factor contributing to cessation of activity. A seasonal rhythm in the growth cycle with a period of complete inactivity is perhaps surprising in a body of water which maintains a good flow throughout the year, and shows that lack of water is not the only factor causing a cessation of growth. The temperature does not reach such extremes in a river as in ponds and lakes, especially shallow ones, and should therefore have less effect as a limiting factor. It is possible that the fall in hydrogen-ion concentration, correlated with decreased flow of the river in summer, may be important in controlling the activity of the fungi. It may be found in years with different weather conditions, e.g. a much wetter spring and early summer, that there is no summer inactivity. The relative percentage of sewage effluent to river water at different times of the year has not been investigated, but it is possible that it may affect the growth of fungi either by changing the hydrogen-ion concentration, or in some other way. The sporadic appearance of some species may be due to their transport from higher reaches and even from sewage and factory effluents. Consequently the fungous flora of a river is subject to change and though perhaps less rich than the still water flora, is relieved of the monotony which may be characteristic of isolated ponds and lakes.

I acknowledge with gratitude the help given by the Thames Conservancy, and by Mr Lloyd and the staff of the Kingston Borough Sewage works in providing details of chemical analyses and rates of flow. The work was carried out partly in the Botanical Department of Royal Holloway College, and the paper has been condensed from part of a thesis submitted for the M.Sc. Degree at the University of London. My sincere thanks are due to Miss E. M. Blackwell, M.Sc., for suggesting the investigation and for her constant encouragement and advice.

Summary

The Hogsmill river is a Surrey tributary of the Thames with constantly alkaline waters maintaining a good flow throughout the year, neither freezing nor drying up.

A short account is given of the sources of the water, seasonal variation in flow, chemical analyses and annual *p*H range.

Of the water moulds only the Phycomycetes are recorded, and of these the family Saprolegniaceae is omitted.

The species described are: *Blastocladia Pringsheimii*, *B. gracilis*, *B. ramosa*, *B. glomerata*, *Gonapodya prolifera*, *Rhipidium continuum*, *R. americanum*, *Phytophthora* (=*Pythiomorpha*) spp., *Pythium* sp., *Pythiogeton uniforme*, *Pleolpidium Blastocladiae*, and a chytrid related to *Pleolpidium inflatum*.

Blastocladia gracilis and the two chytrids are recorded for the first time in the British Isles.

Most of the moulds show a definite seasonal rhythm with maximum growth in winter and disappear in summer. Exceptions are a species of *Pythium* which is found in all months, *Gonapodya prolifera* which is very sporadic in its appearances, and the rarer species of *Blastocladia* which are only apparent when the more prolific species have died out.

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(*Accepted for publication* 21 *January* 1942)

VOLVARIA SURRECTA (KNAPP) COMB. NOV.

By J. RAMSBOTTOM

(With 1 Text-figure)

WHILE waiting for a bus I casually glanced through a dilapidated copy of the third edition of *The Journal of a Naturalist* outside a second-hand book shop. I remembered that this work contained a description and plate of *Mycena crocata*. The plate was there and also the description, but the fungus is not given a name except that of 'stainer' until the fourth edition (1838)—*Agaricus infector*; the plate first appears in the second edition. To my surprise I discovered a text-figure of a *Volvaria* with a description of the fungus under the name *Agaricus surrectus*. The figure does not appear in the first edition, 1829, from which the following is taken, p. 363: the figure is from the second edition, p. 378 (also 1829):

'We have even an agaric, with a bulbous root and downy pileus,* that will spring from the smooth summit of another (agaricus caseus), which has a uniform footstalk, though not of common occurrence. Thus a plant, that itself arises from decay, is found to constitute a soil for another; and the termination of this chain of efficiency is hidden from us.'

The description and figure clearly refer to the species Berkeley named *Agaricus* (*Volvaria*) *Loveianus* (*Outlines Brit. Fungi*, p. 140 (1860)), *Volvaria Loveiana* (Berk.) Quél.

Though *The Journal of a Naturalist* was published anonymously it is well known that the author was John Leonard Knapp (1767–1845). When he wrote he was living at Alveston, Glos., 'not favourably circumstanced for any great abundance of the race of fungi', but he had previously resided for some years in Monmouth, whose 'deep dark woods, and alpine downs' made it particularly favourable for most of the kinds. 'A residence in that portion of the kingdom for

* This agaric is, I believe, unnoticed. I have called it agaricus surrectus.

'Pileus—convex, expanding, covered with a pile of short, white hair; centre depressed; faintly tinted with yellow; from one to three inches in diameter.

'Laminae—loose, irregular, generally four in a set, rather numerous, broad, white, changing to buff, and then pink.

'Stipes—solid, tapering upwards, rather thick immediately below the pileus, three inches high, thick as a reed, white, and often downy, wrapper at the base.

'Many specimens of this singular plant I found in October, 1819, springing from a confluent mass of a. caseus. Bolton's a. pulvinatus is something like our plant; but he describes his under side as perfectly flat, and represents a singularity in the termination of his laminæ, which is not observable in our a. surrectus.'

Agaricus caseus With. is *Clitocybe nebularis*; *Agaricus pulvinatus* Bolt. is *Amanitopsis vaginata*.

some years introduced to my notice a larger portion of this singular race than every botanist is acquainted with. A sportsman then, but I fear I shall be called a recreant brother of the craft, when I own having more than once let my woodcock escape, to secure and bear away some of these fair but perishable children of the groves.'

Certainly a much greater space is given to fungi than is usual in such works and there is a good deal of unusual information about different species. 'That this elegant race has attracted so few votaries many reasons may be assigned. The agarics in particular are very

Agaricus surrectus (× $\frac{3}{8}$).

versatile in their nature, and we frequently want an obvious, permanent character, to indicate the species, affording sufficient conviction of the individual. The rapid powers of vegetation in some will change the form and hues almost before a delineation can be made, or an examination take place, requiring nearly a residence with them to become acquainted with their various mutations; and we have no method of preserving them to answer the purpose of comparison. These are all serious impediments to the investigation of this class; yet, perhaps, I may with some confidence suggest, that any one, who is so circumstanced as to afford the time, so situated as to find a supply of these productions, and will bestow on them a patient

examination, will find both pleasure and gratification in contemplating the beauty, the mechanism, the forms, the attitudes, of the whole order of fungi.'

From the description and figure it is clear that Knapp's specific epithet must be used for the fungus. The change of name is of little consequence as the species is rare: it would be unknown to most botanists but for its parasitic habit.

It may be well to point out that if Konrad and Maublanc be followed in regarding the fungus as a subspecies of *Volvaria hypopithys* (Fr.) Karst., the name *V. hypopithys* subsp. *Loveiana* Konrad & Maubl. would be correct.

(*Accepted for publication* 3 *February* 1942)

PHIALEA MUCOSA SP.NOV., THE BLIND-SEED FUNGUS

By ELIZABETH G. GRAY
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THE occurrence of low germination in seed crops of perennial rye-grass has been investigated since 1923 in New Zealand, where it was ascribed to infection with *Pullularia* (Hyde, 1938). In an account of the 'Blind-seed Disease of Rye-grass' (Neill & Hyde, 1939), a technical description was given, and it was stated that 'the blind-seed fungus appears to be allied to *Helotium herbarum* Fries, both in the ascosporic and conidial stages, and, therefore, pending a clarification of the systematics of the family, is tentatively placed in the genus *Helotium* Fries'. In culture the fungus formed a 'mycelium of the "*Pullularia*" type'.

The fungus first isolated in Britain from seed samples showing low germination was *Pullularia pullulans* (de Bary) Berkhout (Noble, 1939), and, as detailed descriptions and cultures had not then been received from New Zealand, this was assumed to be the fungus of Hyde's account. It was soon found that both the 'blind-seed fungus' and *Pullularia* sp. are frequently present on the same grain (Wilson, Noble & Gray, 1940*a*). Examination of the two fungi showed that they differ in many respects and that the 'blind-seed fungus' could not be associated with the genus *Pullularia*.

At an early stage of our investigation of low germination in rye-grass, we noted the resemblance between the 'blind-seed fungus' and *Endoconidium temulentum* Prill. & Delacr. (1891), a parasite of rye (Wilson *et al.* 1940*b*). Its perfect stage has been assigned in turn to the genera *Phialea* (Prillieux & Delacroix, 1892), *Stromatinia* (Prillieux, 1897) and *Sclerotinia* (Rehm, 1915). Measurements of apothecia, ascospores and microconidia agree closely in the two fungi and the microconidia in all are developed endogenously. Macroconidia have not been described for *Sclerotinia temulenta* and the war has made it impossible to obtain material for comparison. Flowering rye has been successfully inoculated with the 'blind-seed fungus', but apothecia have not so far been obtained from infected rye grains.

It is desirable that the systematic position of the 'blind-seed fungus' should be determined, but the conclusions reached here must be considered tentative until its relationship with *S. temulenta* has been established or disproved.

The 'blind-seed fungus' is an inoperculate discomycete and has features in common with *Sclerotinia*, *Ciboria*, *Helotium*, *Phialea* and more especially with the subgenus *Stromatinia*. It has not been found possible to reach a satisfactory determination based on gross morphological structure. In pursuance of the methods adopted by Nannfeldt (1932), anatomical investigations were made of fresh or dried material of representative species in each genus. Thus fresh material of *Sclerotinia sclerotiorum* (Lib.) de Bary, *Helotium pallescens* (Pers.) Fr. and *Phialea cyathoidea* (Fr.) Gill., and herbarium specimens from the Royal Botanic Garden, Edinburgh, of *Sclerotinia* (*Stromatinia*) *pseudotuberosa* Rehm (Sydow, *Mycotheca germanica*, 2950), *Ciboria caucus* (Reb.) Fuck. (Petrak, *Flora Bohemiae et Moraviae exsiccata*, II, 1, 31, no. 1502), *C. amentacea* Fuck. (Phillips, 116), *Helotium fructigenum* Karst. (Cooke, *Fungi Britannica Exsiccati*, ed. 2, 392), *H. herbarum* (Pers.) Fr. (Sydow, *Mycotheca germanica*, 2724), *Phialea cyathoidea* (*Herb. mycol.* M. C. Cooke, 1885, 24, R. H. Paterson and Phillips, *Elvellacei Britannica*, 79), and *P. strobilina* Sacc. (Phillips, 40 *bis*) were examined, while photographs of *Sclerotinia Candolleana* (Lév.) Fuck. (Wilson & Waldie, 1927), *S. Ficariae* Rehm, *Helotium carpinicola* Rehm, *H. epiphyllum* Fr. and *H. conformatum* Karst. (Nannfeldt, 1932) were also studied. Descriptions given by Starbäck (1895), Durand (1900), Lagarde (1906), von Höhnel (1918) and Nannfeldt were used as additional evidence, although Durand's statements were not always in agreement with the results of observations of European material.

As will be seen from the technical description, the structure of the apothecium of the 'blind-seed fungus' is very uniform and consists throughout of parallel hyphae, forming a typical 'textura porrecta' (Starbäck, 1895), with a very slight tendency to irregularity in the centre of the excipulum immediately under the hypothecium.

In *Sclerotinia*, *Stromatinia* and *Ciboria* the excipulum consists of two layers, the inner of a loose 'textura intricata' and the outer of short-celled hyphae, which turn obliquely outwards and terminate at right angles to the surface. In *Helotium* the excipulum consists of two layers, the inner of a loose 'textura intricata' of slender hyphae, and the outer of wide hyphae which form a 'textura oblita'. In *Phialea* the excipulum consists of slender parallel hyphae which form a 'textura porrecta' in the stalk and merge into a 'textura oblita' under the hypothecium.

Within the genera examined, the anatomy of the apothecium provides a very reliable taxonomic character. The 'blind seed fungus' accords fairly closely in structure with species of *Phialea* and differs markedly from the other genera. Little is known of conidial stages in *Phialea*, but it is hoped that some species may be studied in culture this summer. Meanwhile it is proposed to assign the 'blind seed fungus' to the genus *Phialea*. The specific epithet *mucosa* has been chosen

on account of the slime formed by the macroconidia among the glumes of infected inflorescences.

The only important difference between the description by Neill and Hyde (1939) and that given below lies in the account of the endogenous development of the microconidia. The taxonomic significance of this character is not clear, but recent studies of life histories in the Helotiaceae show it to be of moderately frequent occurrence.

PHIALEA MUCOSA n.sp.

Apothecia small, fleshy, arising singly or in small numbers, 1–7, usually 1 or 2, from colourless, septate, intertwining hyphae, 3–4 μ wide, ramifying throughout the pericarp, testa and endosperm; discs pale pinkish cinnamon, darkening to cinnamon when old, 1–3·5 mm. in diameter, most frequently 2·5 mm., at first almost closed, opening into a cup shape and finally becoming flat or slightly recurved, with a smooth margin; stalks cylindrical, 1–8 mm. long, 0·4 mm. in diameter, smooth; structure fairly uniform throughout, consisting of hyaline, parallel hyphae, occasionally intertwining and seldom branched, forming a 'textura porrecta' with cells in the stalk 20–30 $\times$ 3–4 μ, grading into the more interlaced hyphae of the excipulum, with cells 18–24 $\times$ 4–6 μ, passing gradually into the hypothecium, which is 22–27 μ deep, composed of fine, interlacing hyphae, 2 μ broad; asci cylindrical-clavate, very little thickened at the apex, the pore not staining blue with iodine, 66–116 $\times$ 3·3–7 μ, most frequently 73 $\times$ 6 μ, 8-spored; ascospores smooth, unicellular, ellipsoidal, with pointed ends, biguttulate, hyaline, 7·6–12 $\times$ 3–6 μ, most frequently 9·5 $\times$ 4·5 μ, obliquely uniseriate in the upper half to three quarters of the ascus; on germination each ascospore produces first a terminal germ tube and then a second, frequently lateral in position and usually constricted at the point of origin; paraphyses simple, filiform, hyaline, not swollen at the apex, 2–4 μ broad;

Macroconidia unicellular, uninucleate, cylindrical to slightly crescentic, with rounded ends, usually biguttulate, hyaline, 11–21 $\times$ 3·3–6 μ, most frequently 16 $\times$ 4 μ, developed in summer in very large numbers in succession from the apices of short outgrowths from the hyphae on the pericarp, forming a pink slime on the surface of the ovary; in germination a transverse septum forms, two germ tubes are developed, one from each cell, the first terminal, the other terminal or lateral, or the conidium may remain unicellular and produce only one terminal germ tube;

Microconidia in pink, pulvinate sporodochia, 1–1·5 $\times$ 0·5 mm., on the surface of caryopses; conidiophores septate, guttulate, hyaline, two or three times branched; microconidia unicellular, uninucleate, ovoid, guttulate, hyaline, 3·4–4·8 $\times$ 2·7–3·2 μ, most frequently 4 $\times$ 3 μ,

the first formed by a constriction below the apex of the conidiophore, the rest developed in succession inside a tube, 5 × 3 μ, formed by the terminal portion of the conidiophore; germination not observed; on *Lolium perenne* Linn. and *L. multiflorum* Lam.; apothecia on dead or occasionally on germinated caryopses, in June; macroconidia on the ovary throughout the summer; microconidia on caryopses on the soil, usually in February and March, occasionally found until June; macroconidia by inoculation on *L. temulentum* Linn. and on *Secale Cereale* Linn.

PHIALEA MUCOSA sp.nov.

Mycelio hyalino, sub superficie caryopsidis effuso, 3–4 μ lato; Ascomatibus nunc singulariis, nunc gregariis in una caryopside, gracilibus, carnosis, primum cyathoideis dein applanatis, stipite cylindrico, usque ad 8 mm. longo, 0·4 mm. diametro, disco 1–3·4 mm. diametro, plerumque 2·5 mm., pallido-roseo-cinnamomeis, margine leve, textura omnino porrecta; ascis cylindrico-clavatis, apice vix incrassatis, 66–116 × 3·3–7 μ, plerumque 73 × 6 μ, parte sporifera 50–75 %, octosporis, iodo non coerulescentibus; sporidiis levibus, ellipsoideis, biguttulatis hyalinis, 7·6–12 × 3–6 μ, plerumque 9·5 × 4·5 μ, oblique monostichis; paraphysibus simplicibus, filiformibus, hyalinis, apice non incrassatis;

Conidiis dimorphis, exogenis endogenisque;

Macroconidiis exogenis, cylindraceis vel lunatis, apicibus rotundatis, biguttulatis, hyalinis, 11–21 × 3·3–6 μ, plerumque 16 × 4 μ, singillatim in hyphis brevibus successive natis, dein in massas mucosas in superficie caryopsidis coactis;

Microconidiis in sporodochiis pulvinatis roseis, 1–1·5 × 0·5 mm., in superficie caryopsidis; conidiophoris septatis, guttulatis, hyalinis, bis vel ter repetitio ramosis; microconidiis ovoideis, guttulatis, hyalinis, 3·4–4·8 × 2·7–3·2 μ, plerumque 4 × 3 μ, in interiore ramulorum sporophori nascentiis, dein liberis;

In caryopsidibus *Lolii perennis* Linn. et *L. multiflori* Lam., ascomatibus junio, macroconidiis per aestatem, microconidiis februario martioque.

The 'blind-seed disease' of rye-grass is being studied at the Plant Pathology Laboratory of the Department of Agriculture for Scotland and at the Mycology Department, Edinburgh University. Results of investigations will be published in due course.

I should like to thank Dr Malcolm Wilson and Dr Mary Noble for their advice and assistance with the work, which has been carried out during the tenure of a scholarship awarded by the Carnegie Trust for the Universities of Scotland.

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(*Accepted for publication* 10 *March* 1942)

GLOEOSPORIUM NICOLAI AGGÉRY AND *GLOEOSPORIUM POLYPODII* AGGÉRY

LOOKING through Mlle B. Aggéry's thesis, *Quelques maladies nouvelles des Fougères*, 1935, for possible new genera I was struck by the appearance of the drawings of two fungi described as *Gloeosporium Nicolai* n.sp. and *G. Polypodii* n.sp., the former on *Scolopendrium officinale*, the latter on *Polypodium vulgare*, *P. vulgare* var. *serratum* and *Aspidium aculeatum*.

The drawings and descriptions are conclusive that *Gloeosporium Nicolai* is *Milesia* [*Milesina*] *Scolopendrii* and *Gloeosporium Polypodii* is *Milesia Polypodii* (*Milesina Dieteliana*): the form of *Gloeosporium Polypodii* on *Aspidium aculeatum* is probably *Milesia Whitei*.

In no notice of the thesis I have seen is there any suggestion that the author has misidentified fern rusts as Hyphomycetes. In the ordinary course one would not have called attention to the error except in synonymy. The account of these fungi, however, occupies thirty-nine pages and is illustrated by three coloured plates and forty text-figures. Many new facts are given about the formation and structure of the pustules, the formation and germination of the spores, spore dispersal, penetration of the host, haustorial formation, and the effect of the fungi on the vegetative and reproductive structures of the hosts. It is very careful work and should not be overlooked by those interested in fern rusts.

It is unfortunate that when the author was compiling a list of *Gloeosporium* spp. occurring on ferns she should have overlooked, or not appreciated, the significance of the footnote to *G. Frankii* in Rabenhorst, *Krypt.-Fl.* VII, 494 (1903), for otherwise the form and size of the spores, with their spinous membranes, would have led her to the relevant literature.

J. RAMSBOTTOM

(*Accepted for publication* 3 *February* 1942)

MACOWANIA, HYPOCHANUM OR *MACOWANITES?*

By J. RAMSBOTTOM

THE compilation of a dictionary of fungi provides much of historical and taxonomic interest and many puzzles. Among the latter is the question whether *Macowania*, *Hypochanum*, or *Macowanites* is the correct name for the Gasteromycete described by Kalchbrenner.

The genus was first diagnosed by Kalchbrenner with the name *Macowania* in a paper by M. J. B.[erkeley], 'Two new fungi' in *Gard. Chron.* n.s. v, 785 (1876); the second new fungus was the genus *Kalchbrennera* Berk. The date of publication was 17 June.

It has been generally overlooked that in *Gard. Chron.* n.s. VI, 140 (1876), the number for 29 July, there is a note by Berkeley in which he says, 'We have received a letter from the Rev. G. Kalchbrenner, in which he proposes to substitute for *Macowania* the generic name of *Hypochanum*.' There is good excuse for the oversight, for the sentence is in a general note on fungi among what are usually called 'editorial notes', though it is signed 'M.J.B.' It was, however, appended by W. G. Smith to a reprint of Berkeley's paper in *J. Bot.* XIV, 248 (1876): he added, 'A change is desirable, for Prof. Oliver has already published a genus of Compositae under the former name'; this was in Hooker's *Icones Plantarum*, 1870. The date of this reprint was August.

So far it is plain sailing if we accept the usual view that there should not be homonyms in the different phyla of the plant kingdom. But there is an unusual complication. The descriptions in Berkeley's paper were translated into German and published in *Hedwigia*, XV, 115 (1876), with copies of W. G. Smith's woodcuts which illustrated the original article. The generic name *Macowania*, however, is changed to '*MacOwanites* Kalchbr.' The date of publication was August. The genus is given by De Toni in Saccardo, *Sylloge Fung.* VII, 179 (1888) as '*Macowanites* Kalchr. in *Gard. Chron.* 1876, p. 785 (Etym. a MacOwan cui genus merito dicatun). *Macowania* Kalchbr.' Apparently this has led to the belief that Kalchbrenner himself changed the name, and the change has been generally adopted, e.g. Fischer in Engler and Prantl, Clements and Shear, Coker and Couch, Gäumann.

As *Macowania* is untenable as a fungus name, which of the other two shall be adopted? *Hypochanum* is obviously the valid name on grounds of priority, but can *Macowanites* be conserved?

In view of the published facts this at first appeared impossible. There seemed to be no way out of regarding the name *Macowanites* as a *lapsus calami*. The genus had been published on 17 June. The paper had to be translated and the woodcuts made, before publication could be achieved in *Hedwigia* some time in August. It seemed

most unlikely that Kalchbrenner would write to Berkeley to ask him to change the name and at practically the same time arrange for another name to be published. If a slip had been made who was responsible? Was it logical to validate it with an attribution to Kalchbrenner, for Berkeley (or the translator) or Rabenhorst (the editor of *Hedwigia*) might have been responsible; indeed Rabenhorst might have acted *ultra vires* as editor and made the change.

It seemed a strange error, however, for the ending 'ites' is unusual except for fossil fungi though not unknown, e.g. *Syzygites*, *Cordierites*, *Rozites*, *Sabouraudites* and the absurd *Stalagmites*.

There the matter stood until I found that in *Grevillea*, x, 107 (1882), Kalchbrenner had repeated the generic description (a practice customary with him) with the name *Macowanites*. 'Nomen "Macowania l.c. adhibitum" mutandum erat, cumjam pro genere phânerogamo consumtum sit.' He adopted the change but the question remained whether he was responsible for it. The Berkeley correspondence, which has been moved from the Department of Botany for the time being, contains a letter which settles the problem. On 26 August 1876 Kalchbrenner wrote thanking Berkeley for an extract from the *Gardener's Chronicle* 'MacOwan me quoque attentum addidit, et sic, in litteris ad Rabenhorstium nomen "Mac Owania" in "Mac Owanites" mutavi. Serius tantum mihi innotuit, quod in Bot. Journ. nominis mutatio per vos jam sit facta.'

Thus Kalchbrenner had three bites at the cherry—*Macowania* June 1876, *Hypochanum* July 1876, and *Macowanites* August 1876.

I propose that *Macowanites* (with *M. agaricinus* as type) be conserved because of general usage against *Hypochanum* which to all purposes was stillborn.

The letter mentioned by Berkeley in his note is missing from the correspondence. There are indeed only three letters. In the first, 29 May 1875, Kalchbrenner writes that E. Fries had recommended Berkeley to him as the highest authority on exotic fungi and asks for assistance as he is remote from libraries and has few books and he now has friends in South Africa* and New Holland† (Australia) who are sending him specimens; he could submit drawings and specimens with descriptions for Berkeley's revision. 'Ut in mycologia, ita etiam in Theologia collegan Te saluto.' In the second, 30 April 1876, he thanks Berkeley for a letter of 17 April. Berkeley had apparently accepted *MacOwania* as a new genus and had decided that an *Aseroe* (*Lysurus Tuckii* MacOwan) was also generically distinct. Berkeley had apparently offered to publish the description of the latter and Kalchbrenner asks that he should add that of *Macowania* also, with a drawing which he sends together with full Latin descriptions. It is to be noted that Berkeley had no specimen of *Kalchbrennera*.

* Peter MacOwan. † Sir F. J. Heinrich von Mueller.

(*Accepted for publication* 3 *February* 1942.)

PROCEEDINGS

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 14 November 1941.

The President, W. C. MOORE, Esq., M.A., in the Chair

F. L. STEPHENS and J. RAMSBOTTOM. *Atichia.*

E. S. TWYMAN. *Colpoma quercinum.*

DISCUSSION ON NOMENCLATURE. Art. 20 (*f*) of the International Rules.

'Legitimate botanical nomenclature begins...at the following dates:

'(*e*) Fungi: Uredinales, Ustilaginales and Gasteromycetes, 1801 (Persoon, *Synopsis methodica Fungorum*).

'(*f*) Fungi caeteri, 1821–32 (Fries, *Systema mycologicum*).'

The discussion was opened by Mr J. Ramsbottom. Miss E. M. Wakefield and Dr G. R. Bisby took part.

E. C. LARGE. Sketches of the growth of the potato from planting to harvest, with special reference to humus deficiency.

Two plots of TSA Great Scot from Dartmoor were cultivated at Pinhoe, Devon, in 1941. One plot, in an open garden, received a thin layer of well-rotted compost at tuber level; the other, in an adjoining grass field, dug in February, had a layer of turf buried one spit deep. Both plots received a dressing of superphosphate at 4 cwt. per acre and of sulphate of potash at 2 cwt. per acre. The potatoes were planted on Sunday, 27 April, and on successive Sundays through the growing period, representative plants, complete with their underground parts in situ, were sketched at half-linear scale. This provided a strip cartoon which recorded the effects upon the growth of the plants of the cold dry spring, the rain and fine growing weather in June, and the succeeding long dry spell followed by a wet August. Bulking of the tubers began, in the garden plot, about 6 July, when the green surface exposed to light by each plant was about 34 sq. ft. and the root length was over 100 ft. No symptoms of Leaf Roll or other virus disease ever appeared among the Devon plants. Spots of Early Blight (*Alternaria Solani*) were observed on 20 July. Late Blight (*Phytophthora infestans*) appeared on the plants in the garden plot on 17 August. The spread of Blight at BMS Grade 2 on Great Scot was prevented by spraying with Bouisol at 1 fl. oz. per gallon, i.e. with a copper oxychloride spray fluid containing only one-half the copper present in 1% Bordeaux Mixture. Spraying was repeated a fortnight later; the Blight did not reach BMS Grade 3 until 14 September. The possible critical importance of BMS Grade 2, as the last stage at which spraying can be effective, was borne out by other field experiments.

Symptoms of potash and manganese deficiency first appeared on the *field plot* only, during rain following drought, on 20 July. The deficiency effects progressed very rapidly after 3 August, and by 24 August the productive life of the plants was over. The total crop averaged 1½ lb. per plant, or about 10 tons per acre. No symptoms of mineral deficiency were ever apparent among the plants in the garden

plot, and tuber development continued until 14 September, when uniform autumnal yellowing of the foliage set in. The crop averaged 3½ lb. or 23·3 tons per acre. The soil at tuber level in both plots was analysed after the crops were lifted: the potash figures were in close agreement, and apart from a materially higher phosphate figure for the garden plot and slightly higher *p*H, the principal difference was in the humus content of the soil. This, with evidence obtained when sketching the root systems, suggested that the deficiency effects on the *field plot* were not due to deficiency of mineral salts in the soil, but to lack of sufficient moisture-retaining humus at root level, without which, during the summer drought, the plants were unable to avail themselves of mineral salts.

W. A. Roach. The use of plant injection in plant pathology

Parts of a plant may each be injected with a different liquid, the effects of which can be observed by comparing adjacent treated and untreated regions. Parts as small as a single interveinal area of a leaf and as large as a main branch of a tree may be so studied. Such methods may be used for studying both mineral deficiency diseases and host-parasite relationships. Whole plants may be injected for similar purposes or for curing disease.

These methods are now widely used for the diagnosis of mineral deficiency and are applicable to most plants of commercial importance. The deficiency is made good by the simplest effective method, e.g. by application to the soil whenever this is effective; or by spraying or dusting; or when other methods are less effective, large plants such as trees may be cured commercially by injection. I co-operated in curing apple trees of iron deficiency by injection in this country, peach trees of manganese deficiency in South Africa, both on a commercial scale; and cherry trees in this country have been cured on a small scale of a commercially serious manganese deficiency. Useless barren trees of all three kinds were brought into full bearing.

Although a diagnosis has been made by the interveinal method in two days, a week or a fortnight is usually necessary. The leaf-stalk method is the most generally useful for diagnosis; by it certain leaves are treated on one side of the midrib and left untreated on the other.

Three examples may be given from my own work of host-parasite relationship being affected by injection. The treatment of apple shoots with sodium thiosulphate has controlled mildew (*Podosphaera leucotricha*). Injection of whole apple trees with dipotassium hydrogen phosphate and urea has controlled a severe combined infestation of leaf hopper (Jassidae) and red spider (*Oligonychus ulmi* Koch.). Plum trees have been cured at least temporarily of silver leaf (*Stereum purpureum*) by injection with a disinfectant or a nutrient.

G. Samuel. Some reflexions on the control of virus diseases.

pods in which no hyphae could be found; moreover, the hyphae could not be isolated from discoloured tissues in the pods.

3. The fungus

Portions of diseased stem were cut off and surface-sterilized in 1/1000 mercuric chloride or else by dipping the material in alcohol and flaming. The epidermis and cortex were pared off and thin slices of vascular tissue were transferred to plates of malt-extract agar or of ground rice. Monospore cultures of the fungus were obtained by the dilution method described by Sherbakoff (1915). Preliminary inoculation experiments proved the pathogenicity of the fungus, and for the purpose of identification the fungus was grown on malt-extract agar, wheatmeal agar, oatmeal agar, 2½ % potato-dextrose agar, rice grains and raw potato plugs.

The morphological (Text-fig. 1) and cultural characteristics of the fungus are as follows:

On malt-extract agar. Aerial mycelium abundant, Safrano-pink to pale flesh colour; sporodochia, salmon to flesh-ochre; substratum, violet-purple (Ridgway, 1912).

Measurements of spores from aerial mycelium:

0-septate:	$8.0 \times 2.3\mu$	90 %	Range: $6–12 \times 1.5–3.3\mu$
3 ,,	$35.5 \times 3.27\mu$	10 %	,, $27–43 \times 3.2–4.6\mu$

Chlamydospores abundant in aerial mycelium, solitary, and in chains. Average diameter 8.6μ.

On wheatmeal agar. Aerial mycelium scanty, white; plectenchyma, dark aniline blue.

Measurements of spores from pionnotes:

0-septate:	$8.5 \times 2.9\mu$	80 %	Range: $6–12 \times 2–3\mu$
1 ,,	$12.8 \times 3.0\mu$	3 %	,, $10.5–15 \times 2.5–5\mu$
2 ,,	$19.5 \times 3.0\mu$	1 %	,, $18.0–24 \times 2.9–3.0\mu$
3 ,,	$36.4 \times 3.3\mu$	15 %	,, $19.0–42 \times 2.5–4.5\mu$
4 ,,	$40.8 \times 4.0\mu$	1 %	,, $39.0–42 \times 4.0\mu$

Chlamydospores from aerial mycelium, terminal, intercalary and in chains. Average diameter, 9.6μ.

On oatmeal agar. Aerial mycelium abundant, white to flesh-pink to pale rose-purple; substratum, mauve to litho-purple.

Measurements of spores from pionnotes:

0-septate:	$8.27 \times 2.76\mu$	60 %	Range: $6–12 \times 2.5–3.0\mu$
1 ,,	$16.0 \times 3.15\mu$	1 %	—
2 ,,	$24.0 \times 3.70\mu$	1 %	—
3 ,,	$36.18 \times 3.35\mu$	33 %	,, $27–42 \times 3–4.5\mu$
4 ,,	$42.2 \times 4.0\mu$	4 %	,, $39–48 \times 4–5.0\mu$
5 ,,	$43.5 \times 3.6\mu$	Few	—

On potato-dextrose agar. Aerial mycelium scanty; surface of medium covered with spores in pionnotes. Mycelium, pale flesh colour. Pionnotes, carrot-red.

Measurements of spores from pionnotes:

0-septate:	9·7 × 2·9 μ	12 %	Range: 6–15 × 2·3 μ
1 ,,	14·7 × 3·0 μ	3 %	,, 12–18 × 2·5–3·5 μ
2 ,,	23·0 × 3·4 μ	1 %	,, 15–28 × 3–4 μ
3 ,,	36·1 × 3·2 μ	83 %	,, 30–45 × 3–4 μ
4 ,,	41·6 × 4·0 μ	1 %	,, 39–43 × 4·0 μ

On rice. Aerial mycelium very scanty. Rice grains covered with spores, shrimp-pink to orange-pink.

Measurements of spores from sporodochia:

0-septate:	8·3 × 2·8 μ	6 %	Range: 6–12 × 2·5–3 μ
1 ,,	16·8 × 3·0 μ	3 %	,, 9–27 × 3·0 μ
2 ,,	21·4 × 3·0 μ	1 %	—
3 ,,	36·0 × 3·2 μ	80 %	,, 22–42 × 3–4 μ
4 ,,	42·3 × 3·4 μ	10 %	,, 36–48 × 3–4 μ

The fungus has a marked odour when grown on rice.

On potato plugs. Aerial mycelium abundant, white to Safrano pink to greyish lavender.

Measurements of spores from aerial mycelium:

0-septate:	7·4 × 3·0 μ	70 %	Range: 5–12 × 2·5–3 μ
1 ,,	15·8 × 3·02 μ	3 %	,, 12–21 × 3–3·2 μ
2 ,,	23·6 × 3·20 μ	3 %	,, 18–27 × 3–4 μ
3 ,,	31·8 × 3·3 μ	4 %	,, 27–42 × 3–4 μ

Average of spore measurements on all media:

0-septate:	8·5 × 2·80 μ	56 %	Range: 5–12 × 1·5–3·3 μ
1 ,,	15·3 × 3·03 μ	2 %	,, 10–27 × 3–5 μ
2 ,,	22·2 × 3·18 μ	2 %	,, 18–27 × 3–5 μ
3 ,,	35·3 × 3·28 μ	38 %	,, 19–44 × 2·5–4·6 μ
4 ,,	42·0 × 3·80 μ	2 %	,, 39–48 × 3–5 μ
5 ,,	45·0 × 3·80 μ	Rare	—

Cultures were sent to Dr H. W. Wollenweber who kindly identified the fungus as *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw.

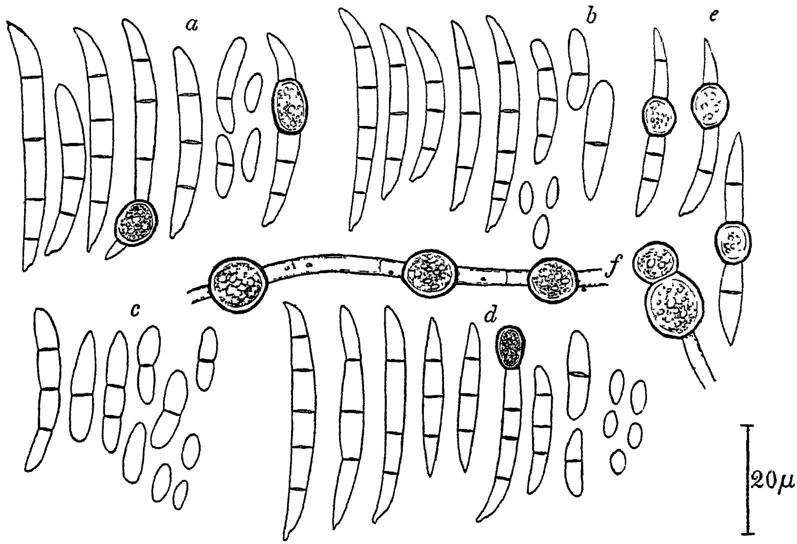
The following description of the fungus is given by Wollenweber and Reinking (1935):

Fusarium vasinfectum Atk. var. *lutulatum* (Sherb.) Wollenw.
Syn. *Fusarium lutulatum* Sherb.

'Distinguished from the type species by rather longer conidia and by the occasional appearance of numerous small blue-black sclerotial bodies up to 0·5 mm. in diameter. The conidia are three-septate, rarely four- and five-septate. The aerial mycelium bears numerous one- or two-celled microconidia. Conidia three-septate, 34 × 3·8 μ; range, 28–42 × 3·2–4·5 μ. Five-septate, 42 × 4 μ; range, 37–47 × 3·5–4·5 μ. Six- to seven-septate conidia (rare), 50–66 × 3·5–5 μ. Chlamydospores terminal and intercalary, one-celled 7 × 6 (6–8 × 5–7) μ. Two-celled, 10·3 × 5·4 (8–12 × 4–7) μ. The fungus gives an aromatic odour.'

Fusarium vasinfectum var. *lutulatum* has a restricted host range; it has been reported by van Hall (1903) from wilted peas, associated with two other species of *Fusarium*, and by Wollenweber (private communication) as the cause of a wilt of *Lathyrus odoratus*. Wollenweber and Reinking (1935) also record its isolation from rotted material of onion, hyacinth, narcissus, China aster, sweet pea, banana and potato.

The effect of temperature upon the growth of the fungus in culture was determined by inoculating the centres of plates of malt-extract agar with spores and mycelium and incubating the plates in triplicate

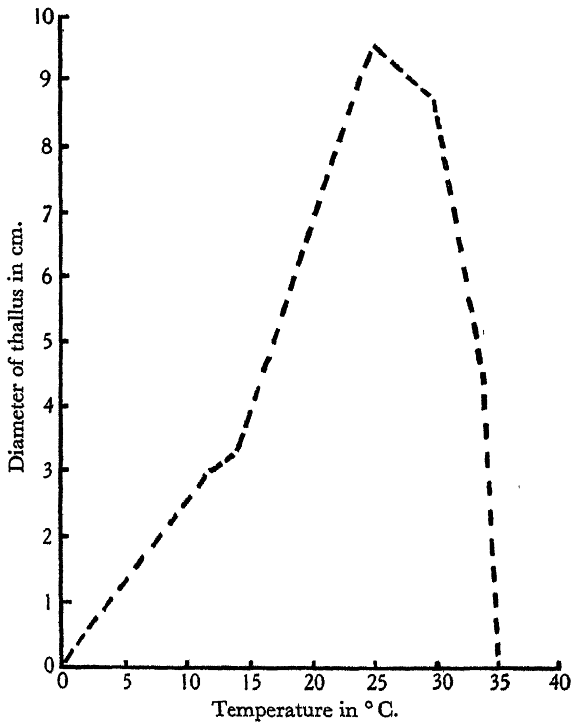


Text-fig. 1. *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw. (*a*) Conidia and conidial chlamydospores from pionnotes on potato-dextrose agar. (*b*) Conidia from rice grains. (*c*) Microconidia from oatmeal agar. (*d*) Conidia from wheatmeal agar. (*e*) Conidial chlamydospores from wheatmeal agar. (*f*) Terminal and intercalary chlamydospores from wheatmeal agar.

at various temperatures between 0° and 40° C. No growth was observed at 0° and 35° C. Growth increased gradually from 2° up to 28° C., the optimum temperature for growth, and then fell rapidly to 35° C. Spores placed in hanging drops of water in Van Tieghem cells were subjected to 15° of frost out of doors, but they germinated within five hours on being placed in an incubator at 28° C. Spores subjected to a moist heat of 40° C. for five hours germinated after a period of five hours at 28° C. The optimum temperature for spore germination is the same as that for growth, and at this temperature the spores germinate in five hours (Text-fig. 2).

4. Infection experiments

Infection experiments were carried out by Ogilvie and Mulligan (1933), and the following are confirmatory of their results. Four isolations of the fungus from different localities in Worcestershire were used throughout the following experiments. In order to infect the soil artificially the fungus was grown on sterilized bran incubated at 28° C. When the fungus was uniformly dispersed throughout the bran, the inoculum was mixed with sterilized soil in trays in the proportion



Text-fig. 2. Relation of temperature to the growth of *Fusarium vasinfectum* var. *lutulatum* on malt-extract agar, after seven days.

of one part of inoculum to nine parts of soil and kept in a greenhouse for from five to seven days. The infected soil was then rubbed through a fine mesh sieve and placed in sterile pots. For the controls, sterile bran was mixed with sterile soil in the same proportions.

Runner beans (var. Giantess Painted Lady) raised in artificially infected soil in the plantation of the Long Ashton Research Station, Bristol, developed wilt symptoms during July 1936, and on taking up these plants the foot of each was found to have been attacked by

slugs. It was thought that the fungus might have entered through these wounds, and experiments were thereupon conducted in which the bean plants were inoculated in the foot.

Bean plants raised in boxes were taken up when 6 in. high and the roots were washed free from soil, particular care being taken to damage the roots as little as possible during the operation. The plants were inoculated by slitting the cortical tissues of the foot and placing fungal mycelium or spores in contact with the vascular tissues. The plants were then placed in pairs in pots containing sterile soil and kept in a greenhouse or out of doors.

Experiment 1, 19 *July* 1936. Sixteen plants were treated in the manner described above and placed in pairs in 7 in. pots in the hothouse. Control plants were wounded in the foot and planted in sterile soil. On 11 August 1936 one plant showed the typical symptoms of the wilt disease and on splitting the stems of all the inoculated plants a vascular discoloration was observed, extending downwards into the roots and upwards to the leaves. The fungus was recovered and identified as *Fusarium vasinfectum* var. *lutulatum*. The control plants were perfectly healthy.

Experiment 2, *April* 1937. Forty plants were inoculated, ten to each fungus isolation, and planted out of doors in deep wooden boxes containing an unsterilized sandy loam. Forty plants were wounded in the foot and planted in a similar box; these served as controls. One plant wilted completely within three weeks of inoculation and two others collapsed after six weeks. The remaining inoculated plants became noticeably infected by the end of August. The general symptoms were identical with those of naturally infected plants; severe infection resulted in the pith and cortical tissues being attacked and decomposed with fructifications of the fungus appearing on the outside of the plants. Unilateral infection was common where the wound made was a single narrow slit which exposed a small area of vascular tissue. The control plants were normal and bore large pods.

Experiment 3, 19 July 1937. Twenty-four runner bean plants raised in wooden boxes were removed from the soil and divided into two lots of twelve. The roots of each plant were washed free of soil and the foot of one lot of plants was wounded and the plants placed separately in 12 in. pots containing infected soil. The remaining plants were unwounded and planted separately in pots containing infected soil. All pots were placed out of doors. Of the twelve wounded plants, four had completely wilted after six weeks and the remaining plants all displayed a vascular discoloration extending throughout the roots and upwards to the first pair of leaves. The unwounded plants became infected also, the whole set wilting completely after eight weeks.

It was concluded that the roots had been damaged in transplanting

and since the experiment was intended to test if the fungus could attack the plants through wounds, or would penetrate the plant tissues unaided, the methods used in this experiment were obviously unsatisfactory. It was therefore decided to sow bean seeds in infected soil so as to overcome the process of transplanting.

Experiment 4, 17 *March* 1938. Six 6 in. pots containing sterile soil were used in this experiment; the soil in three of the pots was infected with the fungus by the method described earlier in this paper. The three remaining pots contained sterile soil. All six pots were kept in a greenhouse for seven days, after which three surface-sterilized bean seeds were sown in each pot. All the seeds germinated and the plants grew normally for a few weeks. By 24 April 1938 two plants in one pot containing infected soil were in an advanced state of wilting. One other plant showed the first symptoms of attack, a yellowing of the primary leaves and a rolling of the margins of the secondary leaves which was followed by yellowing, wilting and shrivelling. On 30 April two more plants had begun to wilt, and by the first week in May all the plants in infected soil were diseased. The control plants in sterile soil were healthy (Pl. XVIII, fig. 2).

Each infected plant was carefully removed from the soil. Examination of the roots showed that no damage had been done by soil pests, but the emergence of secondary roots had caused marked splitting of the cortical tissues.

The experiment thus proved that the bean plant is attacked by the wilt organism in the absence of any damage by soil pests, but it is considered probable that a splitting of the cortical tissues of the foot region by the emergence of secondary roots facilitates the entry of the fungus into the vascular tissues of the plant.

Experiment 5. In order to investigate the possibility of *Fusarium vasinfectum* var. *lutulatum* entering the rooting system of the bean unaided, an experiment of the kind described by Tisdale (1917) was made.

Rolls of filter paper were placed in the bottom of boiling tubes and malt-extract agar was added. The tubes were then plugged with cotton-wool and sterilized. The filter papers were inoculated with the fungus and when they were completely overgrown by mycelium, one surface sterilized bean seed was placed on the top of each roll of paper.

The beans germinated and the plants developed normally for many weeks. Plants were taken from the tubes periodically and the roots and root hairs were examined microscopically. It was found that the roots were always closely invested with a mycelial sheath ending some distance below the foot. No penetration of the epidermal cells of the roots or root hairs by the fungus was observed. It is therefore considered probable that infection takes place primarily as a result of wounding of the foot or of the roots by soil pests and that the natural

mechanical splitting of the foot is also an important factor resulting in infection.

Experiment 6. Ordinary potting soil was artificially infected with the fungus and placed in six 8 in. pots. Three bean seeds were sown in each pot; three were placed in earthenware saucers filled with water and so kept very wet whilst the remaining pots were watered normally. Six control pots containing uninfected soil were divided into two lots of three, one lot kept wet, the other given a normal watering. The first signs of a vascular discoloration were noted on 6 July, and it was equally evident in both series of plants. All plants showed symptoms of wilting by 21 July, but no differences were observed between plants watered excessively and those given a normal watering.

Experiment 7. Runner beans were raised in boxes of unsterilized soil and when they had reached a height of 4 or 5 in. they were inoculated. Narrow slits were made in the stem at various points between the cotyledons and the primary leaves, the slits penetrating to the vascular tissues. Mycelium was inserted into the wounds, the wound covered by moist cotton-wool and bound by adhesive tape.

A number of these experiments were conducted in the greenhouse throughout the autumn and winter of 1935–6 and out of doors during the spring and summer of 1936, but no wilting occurred. The plants grew normally to maturity and bore well-developed pods. Apart from a light brown staining of the tissues at the point of inoculation, and the invasion of a few adjacent cells, the fungus had no effect upon the plants.

Cross-inoculation experiments carried out on dwarf beans (*Phaseolus vulgaris*), broad beans (*Vicia Faba*), sweet peas (*Lathyrus odoratus*), and garden peas (*Pisum sativum*), including stem inoculations, 'foot' inoculations and soil-infection experiments in the greenhouse and in the field, showed these plants to be resistant to the strain of *Fusarium vasinfectum* var. *lutulatum* under investigation.

5. Resistance of varieties

A field trial carried out by Ogilvie and Mulligan (1933) revealed no variety immune from the disease. The following varieties, however, gave the best results on infected ground, in descending order of resistance: Giant Painted Lady, Czar, Sutton's Scarlet, Giantess Painted Lady and White Prize-Winner. Of these Giant Painted Lady was found to be outstanding.

Summary

1. A wilt disease of the runner bean (*Phaseolus multiflorus*), caused by the fungus *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw., is described.

2. The symptoms appear on mature plants as wilted and withered leaves with a dark brown discoloration of the vascular system.

3. *Fusarium vasinfectum* var. *lutulatum* develops in culture from 4 to 34° C. The optimum temperature for growth lies in the vicinity of 26° C.

4. Inoculations on wounded stems above the cotyledons did not induce wilting, but it was easily induced by inoculations of the bases of the plants and by sowing seeds in infected soil. Damage done to the rooting systems by soil pests renders the plant susceptible to attack, and natural splitting of the cortical tissues of the foot region enables the fungus to penetrate to the vascular system, to which the fungus attack is later restricted.

5. Waterlogging of the soil has no appreciable effect upon the severity of the disease.

6. Dwarf beans, broad beans, sweet peas and garden peas did not develop symptoms when inoculated with strains of *Fusarium vasinfectum* var. *lutulatum* isolated from runner beans.

I am indebted to the Long Ashton Research Station, Bristol, for facilities granted to me in connexion with the investigation. I am also indebted to Mr L. Ogilvie for his interest throughout the course of the work and for helpful criticism in the preparation of this paper. The photographs were taken by Mr G. H. Jones to whom the writer extends his sincere thanks; they are published by courtesy of the Long Ashton Research Station.

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DESCRIPTION OF PLATE XVIII

Fig. 1. Right: stems of wilted bean plants showing an intense vascular discoloration. Left: stems of healthy plants.

Fig. 2. Runner bean plants raised from seed sown in inoculated and sterile soil. Right: plants in an advanced stage of wilting. The primary leaves turn yellow, and the margins of the secondary leaves curl. Left: healthy control plants.

(*Accepted for publication* 14 *March* 1942)

Fig. 1

LIST OF HYPHOMYCETES RECORDED FOR BRITAIN. SUPPLEMENTARY NOTE

By E. M. WAKEFIELD and G. R. BISBY

Some errors which missed correction before publication of the List (*Trans. Brit. myc. Soc.* xxv, 49–126, 1941) have been noted, as follows:

ERRATA

p. 54: *Dendrodochium album* and *D. citrinum* are Coelomycetes; see Grove, **1** (II, 131, 133).
p. 75: *Monilia glasti* was on woad, not wood.
p. 80, 8th line from bottom: for *Apionectria* read *Apiocrea*.
p. 82: transfer *Symphyosira* to Phragmosporae, i.e. to p. 97.
p. 98: *Alternaria Tomato*: insert ')' after Cooke.

This opportunity is taken to add some records which have been made since publication of the list, and one, *Aspergillus restrictus*, which was omitted.

Add to p. 53: **Cephalosporium Berthollethianum** Spencer. Dennis & Foister, **28** (xxv, 287, 1942). On Brazil nut, Scotland.
Add to p. 68: **Aspergillus restrictus** G. Smith in **90** (*J. Textile Inst.* xxII, T 115, 1931). Causing mildew in cotton goods.
Add to p. 79: **Penicillium Thomii** Maire: *Add* **28** (xxv, 206–208, 1941). On living leaves of *Cypripedium callosum*, Hertfordshire.
Add to p. 85: **Didymopsis Helvellae** (Corda) Sacc. & March. **54** (xv, 197, 1941). On *Helvella*, Wheatfen Broad, Norfolk.
Add to p. 89: **Cercosporella Primulae** Allesch. **28** (xxv, 209, 1941), on *Primula Juliae* hybrid; **28** (xxv, 295, 1942), recorded from Scotland. Probably a stage in life history of *Ramularia Primulae* Thuem.
Add to p. 92: **Helminthosporium siccans** Drechsler. **28** (xxv, 274, 1942). On *Lolium*, Scotland.
Helminthosporium vagans Drechsler. **28** (xxv, 275, 1942). On *Poa* spp. Scotland.
Add to p. 94: **Ramularia Cicutae** Karst. **54** (xv, 198, 1941). On *Cicuta virosa* L., Wheatfen Broad, Norfolk.
Ramularia deflectens Bres. **28** (xxv, 299, 1942). On cultivated *Viola* hybrids, Scotland.
Ramularia 'Epilobii-palustris' Allesch. **54** (xv, 198, 1941). On *Epilobium palustre* and *E. tetragonum*, Wheatfen Broad, Norfolk.
Add to p. 96: **Septocylindrium aromaticum** Sacc. **54** (xv, 198, 1941). On *Acorus Calamus*, Wheatfen Broad, Norfolk.
Add to p. 97: **Septocylindrium Ranunculi** Peck. **54** (xv, 198, 1941). On *Ranunculus repens*, Wheatfen Broad, Norfolk.
Alternaria radicina Meier, Drechsler & Eddy. **31** (cxI, 172, 1942); **28** (xxv, 282, 1942), Scottish record. Causing black rot of carrots in store.
Add to p. 99: **Fumago salicina** (Pers. ex Fr.) Tul. **54** (xv, 197, 1941). On honeydew on *Salix* and *Malus*, Wheatfen Broad, Norfolk.

(*Accepted for publication* 31 *July* 1942)

DISCUSSION ON MYCOLOGICAL NOMENCLATURE, 21 FEBRUARY 1942

WHY RULES?

By E. M. WAKEFIELD

I. *Historical summary*

Before the time of Linnaeus, a botanist wishing to refer to any particular plant was obliged to use a descriptive phrase. If the plant was very distinct perhaps two words would be sufficient, but as more species became known the more complicated became the phrases necessary to describe them. Thus the common mushroom was for Bauhin (1596) 'Fungus campestris albus superne inferne rubens', while Micheli in 1729 distinguished various species and varieties of what we now call *Agaricus* as 'Fungus esculentus albus', 'Fungus esculentus magnus', 'Fungus esculentus nemorosus', etc., often with further descriptive words added. *Xylaria Hypoxylon* was for Ray (1690) 'Fungus ramosus, niger, compressus, parvus, apicibus albidis', so described to distinguish it from other branched fungi such as *Clavaria* spp.

Linnaeus's great service to all biology was the establishment of a system of binary nomenclature, whereby each plant and animal received a simple name consisting of two words only, one denoting the genus to which it belonged and the second the species. Further, Linnaeus used great care in the delimitation of generic and specific characters, and this with his system of classification gave an impetus to the study and description of plants and animals. Linnaeus himself knew very little of fungi, and his *Species Plantarum* includes the names of only ten genera. Following him, however, came local fungus floras and large illustrated works, as for instance Schaeffer, Müller in the *Flora Danica*, Bulliard in France, Willdenow, Link, Tode, and Schrader in Germany, in England, Bolton and Sowerby, and then C. H. Persoon, whose *Synopsis Methodica Fungorum* (1801) was the most important work on European fungi published up to that date. Later on came Albertini and Schweinitz, Nees von Esenbeck, and then Elias Fries, whose *Systema Mycologicum* (1821–32) is to the mycologist what Linnaeus's *Species Plantarum* is to the phanerogamist.

All these works naturally dealt chiefly with European species, but even at the end of the seventeenth century fungi had begun to trickle in from overseas. Fries received many species, and, with improved facilities for classification and identification, collectors were encouraged, and presently we have M. J. Berkeley, Montagne and others describing hundreds of new species and genera received from all over the world.

As long as the number of books and of described species remained relatively few, it was an easy matter to decide whether any plant received had been previously described or not. With increased botanical activity, however, difficulties of identification necessarily arose, since with the lesser bibliographical facilities of those days it became difficult for any one worker to be sure that he had seen all the relevant literature. The need for a complete index of all described species of plants was early recognized by phanerogamists, and was met first by Steudel's *Nomenclator Botanicus*, published in 1821, and followed in 1824 by a companion volume dealing with cryptogamic plants. Names of fungi were included in Pfeiffer's *Nomenclator Botanicus* (1873–4), which compiled names published up to the end of 1858. The first complete index to fungus names only was Streinz, *Nomenclature des Champignons*, 1863, which enumerated less than 12,000 species. The first eight volumes of Saccardo's *Sylloge*, published between 1881 and 1889, compiled nearly 32,000 names.

The compilation of these indexes revealed that confusion already existed in the use of names. Sometimes a name given to a fungus had already been used for a plant belonging to some other group, as for example *Crouania* Fuck. (1869), a duplicating name or *homonym* of *Crouania* Ag. (1842), a genus of Algae. Saccardo recognized this and changed the name to *Barlaea* Sacc. (1889), but in so doing fell into a similar mistake, since there was already a *Barlaea* Reichenb. among the Orchidaceae. Similarly *Lachnea* Gill. (1879) duplicated

Lachnaea Linn. (1763), a genus of Thymelaeaceae, *Kneiffia* Fr. (1838) was antedated by *Kneiffia* Spach (1835); *Sphaerella* Ces. & De Not. was a later homonym of *Sphaerella* Sommerf. in the Algae, and *Marssonia* Fisch. (1874) a homonym of *Marssonia* Karst., belonging to the Gesneriaceae. There are numerous examples of such homonyms in different groups, but sometimes also names of fungi were duplicated; for instance *Barclayella* Sacc., a genus in Melanconiaceae, was found to be antedated by *Barclayella* Diet. in the Uredinales; Saccardo therefore later altered the name of his genus to *Neobarclaya.*

With the abundance of material then coming in, and the development of the microscope, mycologists began in the first half of the nineteenth century to do more than just name and list fungi. Critical work resulted in monographs dealing with single genera or groups of genera, and reviewing all the previous literature. Such work often led to two discoveries, (1) that species had been described under genera to which they did not belong, according to modern ideas, and would have to be transferred, or (2) that the same plant had been described more than once under quite different names. Thus *synonyms* were recognized.

Again, names of both genera and species had sometimes been changed because the author who did so objected to the form or the spelling of the original name. Saccardo changed *Cellulosporium* Peck to *Cytosporium* because *Cellulosporium* is made up of a Latin and a Greek word; he changed *Ostreichnion* Duby to *Ostreion*: *Pestalotia* De Not. (1839) was changed to *Pestalozzia* by Corda (1842), *Papulaspora* Preuss had become *Papulospora*, and so on. Some of the most flagrant cases of arbitrary changes are to be found in Clements, *Genera of Fungi*, and the second edition by Clements and Shear, as for instance *Chaetosira* Clem. instead of the valid *Wiesneriomyces* Koord., *Helicobasis* for *Helicobasidium*, and many other similar abbreviations of long names.

The confusion existing in regard to the use of names of phanerogams led Alphonse de Candolle in 1867 to formulate a set of rules, or 'Lois', to be observed in botanical nomenclature, and it is a remarkable testimony to De Candolle's grasp of essentials that these Laws have remained the basis of all codes proposed up to the present time. The first article stated that 'Natural History can make no progress without a regular system of nomenclature, acknowledged and used by a large majority of naturalists in all countries'. This, with some modification, remains the first article of the Rules of botanical nomenclature which we use to-day.

In 1867, as now, there were divergent opinions, and unfortunately De Candolle's Laws were not universally accepted. For instance, while some maintained that the correct name of a species should include the first specific epithet given to it, no matter under what genus, there were others (among them the first compilers of the *Index Kewensis*) who considered that the first name given in the accepted genus should be that to be maintained. The natural corollary of this second view was that the epithet of a species might be changed whenever taxonomic study necessitated its removal to another genus.

Between 1891 and 1898 Otto Kuntze published in three volumes a work entitled *Revisio Generum Plantarum*, in which with Teutonic thoroughness he examined existing generic names of both phanerogams and cryptogams, and showed how often botanists had neglected earlier names when describing new genera. Starting with the first edition of Linnaeus, *Systema Naturae* (1835), Kuntze applied rigidly the principle of priority laid down in the Laws, and by so doing found it necessary to change the names of over 30,000 species, with a correspondingly large number of genera. Of these genera over 200 were names of fungi. Kuntze's views on priority were largely ignored in Europe, but received wide acceptance in the United States. One reason for this was probably the fact that strict adherence to priority did not involve so many changes in the names of American plants as it did in the much longer known plants of the Old World. The work of Kuntze had this beneficial result, that it roused botanists to consider the need for Rules which would ensure the greatest amount of stability in nomenclature.

At a Botanical Congress held in Vienna in 1905 an attempt was made to obtain international agreement by detailed discussion of proposals for Rules. The results were incorporated in the *International Rules of Botanical Nomenclature*, published in 1906. There was, however, opposition especially on two points, namely the compulsory use of Latin for descriptions of new groups, and the provision for exceptions to the rule of priority for genera. These articles were unacceptable especially to some United States botanists, with the result that in 1907 the American Code of Botanical Nomenclature came into being. This Code insisted on rigid priority for all groups, starting from Linnaeus's *Species Plantarum* (1st ed. 1753), and also allowed descriptions in any language. For the next

twenty-five years the use of these two different sets of Rules was responsible for many differences in plant names as between the two sides of the Atlantic. For instance, Murrill adopted the specific epithet *pseudoboletus* of Jacquin, for what we call *Ganoderma lucidum*, and revived certain old generic names such as *Gymnopus* Roussel (1806).

Meanwhile in 1910 a third International Congress held at Brussels considered some amendments and additions to the International Rules, notably as regards the nomenclature of Cryptogams. The date 1753, which was the starting-point fixed for Phanerogams and Ferns, was considered too early for the Fungi, and at Brussels two works were decided on, namely Persoon's *Synopsis Fungorum* (1801), for the Rusts, Smuts and Gasteromycetes, and Fries's *Systema Mycologicum*, published in three volumes between 1821 and 1832, for the rest of the Fungi. Myxomycetes and Lichens were treated separately, and both these groups start from Linnaeus, 1753. To avoid disadvantageous changes which might result from strict application of the rule of priority, provision was made in 1905, and has been maintained in all subsequent editions of the Rules, for a list of generic names which would be treated as exceptions, *Nomina generica conservanda*.

Fortunately, by means of full discussion and some compromise agreement between the opposing schools of thought was at last reached at the International Botanical Congress held at Cambridge in 1930, and various details were threshed out at the succeeding Congress at Amsterdam, in 1935. Some points, however, still remain to be decided.

II. *The present Rules*

The International Rules as they stand may appear very complicated, but this is inevitable owing to the necessity of clearing up the confusion caused by non-observance of Rules in the past. Briefly, the provisions of our Rules may be classified as follows:

A. *Principles*

Articles 1–18 lay down general considerations and guiding principles, such as the necessity for Rules which all can understand, stability in nomenclature, the principle of priority in the use of names, the type method for determining the use of names, and the construction of names preferably from Latin and Greek. Also the various categories of taxonomic groups—Division, Class, Order, Family, and so on down to varieties and forms—are defined.

B. *Rules*

The remaining Articles, 19–74, consist of Rules, together with some additional Recommendations dealing with subsidiary points. The Rules concern:

(1) *Limitation of priority by fixing definite starting-points for each group.* As already mentioned those for the Fungi are Persoon's *Synopsis* (1801) for Rusts, Smuts and Gasteromycetes, and Fries's *Systema* (1821–32) for the remaining groups. In addition, Art. 21 provides for exceptions to the Rules, by the conservation of generic names which have come into general use, but which are not really legitimate. Such names may be proposed for conservation by anyone giving due notice to the Committee for Nomenclature at an International Botanical Congress, but they are not established until after they have been examined carefully as to their value and implications by a committee of competent authorities appointed for the group in question, and then passed by a general vote at the next Congress after recommendation by such a Committee. Pending the decision of Congress, however, botanists are authorized to use such names as have been proposed for conservation if they wish to do so. In accordance with this rule, long lists of conserved names of *Phanerogams* have been passed and are published as Appendices to the Rules.

For the *Fungi*, proposals for conserved names have been in existence since 1910, when Saccardo submitted a list to the Brussels Congress, but unfortunately too late for consideration by the mycological committee then in being. The first collected list of proposals was published in connexion with the 1930 Congress. Apparently a great many of these proposals were made simply in opposition to what Otto Kuntze had done, and a cursory examination is enough to show that not all of them are sound, and some in fact are unnecessary. Yet nothing has yet been done by the International Mycological Committee in the matter of examining these proposals and accepting or rejecting them. Because of this crying need the Nomenclature Committee appointed by the British Mycological Society in 1939 made a start with the task; three contributions have been published, and the results circulated to members of the International Committee. Unfortunately, the difficulties of war-time conditions have temporarily put an end to this work.

Another Article which affects priority is Art. 57, which states that in fungi with a pleomorphic life-cycle the correct name is the earliest which has been given to the *perfect* stage, provided that it is otherwise in accordance with the Rules. Ascomycetes and Basidiomycetes are specifically mentioned, but the Phycomycetes are not. There is some doubt whether the Rule can be applied to the Phycomycetes.

(2) *The methods of designating the various categories of taxonomic groups*, e.g. the termination *-ales* for Orders, *-aceae* for Families and so on. Also rules and recommendations are given for the formation of generic and specific names.

(3) *Conditions of valid publication of a name.* It must be (*a*) effective, that is, printed or indelible matter which is on sale to the public or distributed to representative institutions, and (*b*) it must be accompanied by a description giving the diagnostic characters; after 1 January 1935 this description must be in Latin.

Examples: Numerous new generic names were published in a paper on the classification of Fungi Imperfecti by von Höhnel, which was printed after his death. No descriptions of these new genera were given and they can seldom be identified from the key characters. Such names are called *nomina nuda* and are not valid. Unfortunately *nomina nuda* are often perpetrated when collectors publish lists containing new names which have been given them in manuscript by specialists, but have not yet been described by those specialists. One cannot too strongly emphasize that names should not thus be published without the permission of their author, for even specialists have been known to change their minds.

(4) *Citation of authors' names for purposes of precision.* This is a necessary consequence of the type method of determining the application of names. The name of the author who first describes a new group is attached to its name, and if the position of the group is changed, then the name of the first author must be cited in brackets and the name of the author who makes the change added outside the brackets.

(5) *Names which are to be retained when groups are remodelled, divided, united, or transferred to other groups, with or without change of rank.* I would ask you to note here a point which is not always appreciated, namely that nomenclature must follow taxonomy. Changes of name may be due to two reasons: one is increase of knowledge about the plants themselves, resulting in changed views about the circumscription of groups, and the other is the consequences of the Rules themselves, as when earlier synonyms or homonyms are detected.

(6) *Names to be rejected, or* illegitimate *names.* These include *later homonyms* (already mentioned), names which have been used in different senses and have thus become a permanent source of confusion (*nomina ambigua*), as for instance *Hypochnus* (see *Trans. Brit. myc. Soc.* XXIII, 224), *Hypospila* (*Trans. Brit. myc. Soc.* XXIV, 284–5), names whose application is uncertain (*nomina dubia*), e.g. *Aldridgea* Mass.; names of groups whose characters were derived from discordant elements (*nomina confusa*), e.g. *Hypolyssus* Pers., described from an Agaric attacked by a *Hypomyces*, and *Heterobasidium* Mass., a resupinate Basidiomycete (? *Stereum*) on which a Pyrenomycete was growing; and groups based on monstrosities, e.g. *Mycodendron* Mass., *Bresadolia* Speg., *Myriadoporus* Peck.

(7) *Orthography of names.* The original spelling of names must be retained except when there is a typographic error or an obviously unintentional orthographic error. Consequently Guba was correct in reinstating the generic name *Pestalotia* in place of the spelling *Pestalozzia*. The latter could only be retained by getting it placed on a list of conserved names.

(8) *The type method of applying names.* This is recognized as a principle (Art. 18), and in the rule as to conservation of generic names it is stated that the application of a conserved name is decided by its type. Again there is a recommendation that authors publishing names of new groups should indicate what is their nomenclatural type (not necessarily the most typical form), i.e. type specimen for a new species, and type species for a genus. Thus each name becomes permanently associated with a particular type or standard.

These then are the main provisions of our Rules in outline. There are numerous points of detail dealt with, in particular as to the various complications which may arise when a species or a variety is transferred from one genus to another, or changed in rank. It is necessary to consult the Rules themselves in all cases of difficulty.

As an example of the working of the Rules, take the following names applied to species of *Gloeosporium* which cause anthracnoses, especially on fruits:

Septoria rufomaculans Berk. (1854), on grape.
Gloeosporium fructigenum Berk. (1856), on apple.
Gloeosporium laeticolor Berk. (1859), on peaches and nectarines.

Ascochyta rufomaculans (Berk.) Berk. (1860) (transference of *Septoria*).
Gloeosporium versicolor Berk. & Curt. (1874), on apple.
Gloeosporium rufomaculans (Berk.) Thuem. (1879) (transference of *Septoria*).
Gloeosporium piperatum Ell. & Ev. (1889), on *Capsicum*.
Colletotrichum nigrum Ell. & Halst. (1890), on *Capsicum*.
Gloeosporium cingulatum Atk. (1892), on privet.
Also numerous other spp. of *Gloeosporium* and *Colletotrichum*—e.g. on cacao, tea, etc.
Gnomoniopsis Stoneman, 1898 (a later homonym of *Gnomoniopsis* Berl.).
Gnomoniopsis cingulata Stonem. (1898), on privet.
Gnomoniopsis piperata Stonem. (1898), on *Capsicum*.
Gnomoniopsis fructigena Clinton (1902), on apple.
Glomerella Spauld. & v. Schrenk (1903) (to replace *Gnomoniopsis* Stonem.).
Glomerella rufomaculans (Stonem.) Spauld. & v. Schr. (1903), on apple.
Glomerella cingulata (Stonem.) Spauld. & v. Schr. (1903).
Glomerella fructigena (Clint.) Sacc. (1905).

If all these are one and the same species, the correct name is *Glomerella cingulata* (Stonem.) Spauld. & v. Schr. (1903), a change of *Gnomoniopsis cingulata* Stonem., the first name applied to the perfect stage.

If, however, the fungus causing Bitter Rot of apple is not the same as all these other species of *Gloeosporium*, etc. then its correct name is *Glomerella fructigena* (Clint.) Sacc.

If the rule were to take the earliest name for any stage, there would be less stability, for there would always be the possibility of a still earlier specific epithet than *rufomaculans* being detected.

In conclusion I will indicate points on which mycologists should make up their minds before any further revision of the Rules is undertaken. Some proposals were brought before the last Congress at Amsterdam in 1935, but decision on all of them was postponed until they could be examined thoroughly as to consequences. These were:

(1) To start the nomenclature of the Uredinales from Linnaeus, *Species Plantarum*, 1753.

This would give yet another starting-point for fungi, and should be perhaps considered in connexion with an old proposal to start all groups from Linnaeus. The latter is not very practicable.

(2) To regard the first date, 1821, of Fries's *Systema* as the starting-point for all groups of fungi other than those which begin from Persoon. The alternative is to start each group from the date when it was dealt with in the *Systema*, as for instance Discomycetes and Tremellaceae 1822, Hyphomycetes 1832. This latter practice is what is usually followed.

(3) To recognize the Friesian subgenera of *Agaricus* as genera.

This has been done in effect in many works, notably by Saccardo and by Rea, because if one does not, it is sometimes very difficult to find out who first made the combination for any particular species. The suggestion is however quite contrary to the Rules, and its opponents regard it as slipshod.

Further, we must complete the examination of all names which have been proposed for conservation, and also submit cases for any other generic names we wish so to retain. At the same time we should very carefully typify such genera, selecting, where no type was originally specified, a species which will conserve the sense in which the genus is now accepted. The rules for the selection of types which were promised as an appendix to the International Rules have not yet been formulated, but much can be done by study of the rules observed in the American Code, and by the application of common sense. The intention of the Rules is to bring stability into nomenclature, not to make needless changes by pedantic adherence to the letter rather than the spirit.

NEW SPECIES AND OLD

By E. W. MASON

The recently introduced type method of applying names, incorporated into the International Rules in 1930, sharply differentiates for us the two kinds of synonyms that may be termed the obligate and the facultative. My first example is taken from Seaver and Chardon (1926):

obligate synonyms { 'Pucciniopsis Caricae (Speg.) Seaver (1926) / syn. Cercospora Caricae Speg. (1886) } facultative synonyms { Pucciniopsis Caricae Earle (1902)'

The names '*Pucciniopsis Caricae* (Speg.) Seaver' and *Cercospora Caricae* Speg. have the same type specimen, broadly speaking the material from which Spegazzini in 1886 drew up his original description. That is what '(Speg.)' now signifies. They are accordingly alternative names for exactly the same species; and so obligate synonyms because their synonymy is not a matter of opinion, but of definition. *Pucciniopsis Caricae* Earle, on the other hand, has a different type specimen, the material from which Earle in 1902 drew up his description. Its synonymy with the other two names is a matter of judgment or opinion, and so can never be accepted outright, but accepted only with this proviso: without prejudice to further evidence. This name should accordingly be discriminated as only a facultative synonym of the other two.

Further, when Earle in 1902 validly published the binomial *Pucciniopsis Caricae*, he pre-empted the specific name *Caricae* in the genus *Pucciniopsis* for the species based on his own material. '*Pucciniopsis Caricae* (Speg.) Seaver (1926)' is accordingly illegitimate, as a later homonym of *Pucciniopsis Caricae* Earle (1902). These two names then are homonyms, i.e. they are the same name based on two different types; they are also facultative synonyms, i.e. names that have been held to refer to the same taxonomic species. Before the introduction of the type method, they could also perhaps have been held to bear yet a third relationship, i.e. to be in fact the same name for the same thing. For, then, the author of a species was held to have delimited it with his diagnosis, so that his species could be envisaged as consisting of all the specimens which answered to his description. Then the limits imposed by Earle's description, and the limits imposed by Spegazzini's description emended by Seaver, might well be identical, and the two species be the same not only in name but in everything else also. But now that an author's species is to be envisaged as consisting of all the specimens that can properly be grouped about his type specimen, species based on distinct type specimens must, in nomenclature, themselves be held distinct.

In my other two examples, the authors of Saccardo's *Sylloge* have raised the same issue, but confused it by attributing to Patouillard and to W. G. Smith respectively specific transfers that they never made.

Saccardo (1888) cited a name as '*Helicobasidium purpureum* (Tul.) Pat.'; on referring to the literature cited, however, the facts appear as follows. In 1865, *Hypochnus purpureus* Tul. was proposed as new, and in 1885 *Helicobasidium purpureum* Pat., also as new. Each then is based on its own type specimen; and the two names can never be more than facultative synonyms. Saccardo's false citation '*Helicobasidium purpureum* (Tul.) Pat.' accordingly is not only illegitimate as a later homonym, but also has two uncompromisingly distinct type specimens, and that is absurd. But another point arises here, for the type of a generic name is a species. Now *Helicobasidium purpureum* Pat. is the type species of the genus *Helicobasidium* Pat. (1885), and *Hypochnus purpureus* Tul. was transferred in 1887 to become the type species of *Stypinella* Schroet. Again, then, these generic names can be no more than facultative synonyms, and never obligate synonyms, as they would have been, had Saccardo's false citation been correct.

In these first two examples, no one has yet suggested that this nice nomenclatural distinction makes any great difference; in my third example, however, it might well have been invoked, and might have then perhaps made all the difference. De Toni (1888) cited a name as '*Urocystis Gladioli* (Requien) W. G. Smith'. The literature he cited, however, shows that W. G. Smith proposed *Urocystis Gladioli* W. G. Smith as new, and

had nothing at all to say about the prior *Uredo Gladioli* Requien ex Duby. De Toni's incorrect citation of '*Urocystis Gladioli* (Requien) W. G. Smith' was in time taken up by British mycologists, among others, and has been incorporated into the List of Common Names of British Plant Diseases. The succession of consequences of this false citation is still incomplete.

Dodge and Laskaris (1941), however, fully described a Hyphomycete on *Gladiolus* in U.S.A.; and although they suggested that their fungus was more likely to represent Smith's species than Requien's, they called it *Papulaspora Gladioli* (Requien) Dodge and Laskaris. The immediate point of general application that I desire to make, and I do not think that it has been taken before, is this. Assuming that they desired to use the binary name *Papulaspora Gladioli*, they had three choices open to them: (i) to risk transferring *Uredo Gladioli* Requien to *Papulaspora* and so accept Requien's type as their type: that is what they did; (ii) transfer *Urocystis Gladioli* W. G. Smith, and so accept Smith's type as their type; or (iii) scotch both these equivocal species inside the genus *Papulaspora* by proposing *Papulaspora Gladioli* as new, with their own indubitably *Papulaspora* material as its type specimen. Let us assume the third, and that either Requien's or Smith's species had later proved the same as this hypothetical new species. Then no harm could have resulted; then either or both, as the facts emerged, could have been listed as its facultative synonyms. But now that the only legitimate *Papulaspora Gladioli* has been published as an obligate synonym of *Uredo Gladioli* Requien, what if the latter after all should still prove a *Urocystis*? That indeed would be a pity.

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WHO IS THE AUTHOR?

By G. R. BISBY

Most mycologists accept the citations and abbreviations of authors from any handy source. No doubt the name of the author is of less importance than that of the fungus; nevertheless, the International Rules of Botanical Nomenclature, under which good mycologists labour, give us advice which we should try to follow—or to improve. Botanists require, when necessary, the double citation of authors, though zoologists cite only the first author of a name.

I. Articles 46–9: *It is necessary to cite author or authors*; Art. 20: *Legitimate nomenclature of Uredinales, Ustilaginales, and Gasteromycetes begins with Persoon* (1801); *of Fungi caeteri with Fries* (1821–32).

Thus, for example, *Ustilago* (Pers.) Roussel (Persoon, 1801, had *Ustilago* as a subgenus of *Uredo*); *Puccinia graminis* Pers. [1794] 1801; *Lycoperdon* Pers. or, 'if useful or desirable' *Lycoperdon* [Tourn. 1700, p.p.; Mich. 1729] Pers., or *Lycoperdon* Mich. ex Pers.; *Geastrum* Pers. (syn. *Geaster* Mich. ex Fr.); *Botrytis cinerea* Fr. (or Pers. ex Fr., but not *B. cinerea* Pers.); *Cladosporium herbarum* Fr. is obviously usually more 'useful and desirable' than *C. herbarum* [(Pers.)] Link ex Fr.; *Amanita muscaria* (L. ex Fr.) S. F. Gray or, in my view much better, *A. muscaria* Fr. unless and until Congress may reject a proposal now before it that Fries's subgenera of Agaricaceae be treated as genera; *Hysterium* Fr. or, for formal purposes, *Hysterium* [Tode] Fr. em. Sacc.

A name not accepted by Persoon (1801) or Fries (*Systema*) is taken to be validated by its first subsequent use by these or other authors. Thus *Alternaria tenuis* Nees (1817) ex Wallr. (1833) would be an example, were it not for the fact that this common usage amounts to the conservation of a specific name, which is illegitimate. Fries accepted the species *A. tenuis*, but considered it a *Torula* and renamed it *T. alternata*, evidently because

there was already a *T. tenera*. So, as Mason noted fourteen years ago, *alternata* is the correct specific epithet, though the combination has apparently not yet been made. There is much to be said for the conservation of a few common and important specific names. Of course the same effect can sometimes be achieved, as with *Alternaria tenuis*, by letting the sleeping dog lie; furthermore, as is well known, one cannot make every mycologist drop a familiar name just because it is illegitimate.

II. Art. 57: *A fungus (Ascomycetes and Basidiomycetes mentioned) with pleomorphic life-cycle can bear only one binary name, the earliest valid name applied to the perfect form.*

Thus, for example, *Cymadothea Trifolii* Wolf, not (Pers. ex Fr.) Wolf, for Persoon's *Sphaeria* was pycnidial; *Sclerotinia Gladioli* Drayt., and so on. However, Article 57 needs rewording, for it is obvious that mycologists frequently should and must continue to use names of Fungi Imperfecti. *Cladosporium herbarum* is now technically illegal; its name should be *Sphaerella Tulasnei* Janczewski, 1893, stat. conid.

C. album Dowson (i.e. *Hyalodendron album*) has been reported to have *Erostrotheca multiformis* as its perfect stage; but I believe it would be better not to use the latter name in Britain until the connexion has been verified, the status of *Erostrotheca* settled, and this stage found here.

As for the application of Rule 57 to Phycomycetes, I am convinced that it should not be attempted and is against the spirit of the Rules. The imperfect state of a Phycomycete is generally the more diagnostic and conspicuous. The following are a few .possible examples of trying to apply Rule 57:

Phytophthora infestans [W. G. Smith??] Smorawski? (imperfect state *P. infestans* (Mont.) de Bary); *Pilobolus crystallinus* [Zopf??] Krafczyk?; *Peronospora Schachtii* Prill. (heretofore attributed in error to Fuckel); P. sp. (name and author indet.; syn. the invalid *P. parasitica* (Pers. ex Fr.) Tul.); *Rhizopus nigricans* de Bary (if de Bary first described zygospores), syn. *R. stolonifer* (Ehrenb. ex Fr.) Lind—and so on to little purpose; much work needed for hundreds of names, with no certainty that they would be right.

Since the International Rules aim at fixity of names and avoidance of confusion (Art. 4), it seems to me that Article 57 should not apply to Phycomycetes; also that the subgeneric names of Agarics in the *Systema* should be considered as generic; and that a very few specific names in constant use should be conserved.

Finally, who is the author of a name such as *Pseudonectria Rousseliana*? The genus *Pseudonectria* Seaver was described with 'Type species: *Nectria Rousseliana* Montag.' According to the letter of the law, the first writer who made, intentionally or unintentionally, the combination *P. Rousseliana* is the authority for the transfer; but since his publication may be difficult or impossible to find with certainty, I favour following the spirit of the Rules and citing the authorities as '(Mont.) Seaver'. In my view, conservatism should be used in nomenclature as well as in taxonomy.

After speaking on 21 February, I sent proposals about as follows to *Phytopathology*:

'1. *That the conservation of specific names of Fungi be legalized.* This should apply only to a few names that can be shown to be really important in the view of the great majority of mycologists, including "applied mycologists". I suggest these for consideration: *Tilletia Tritici*, *T. laevis*, *Ustilago levis*, *Rhizopus nigricans*, and especially about a score of pre-Friesian names of Powdery Mildews used by Salmon and all subsequent mycologists, and which could be badly confused by anyone who tried to interpret the Rules to the letter.

'2. That Article 57 be rewritten about as follows: *Among Ascomycetes and Basidiomycetes (but not Phycomycetes) with pleomorphic life-cycle, the first valid binary name applied to the perfect state of a species takes precedence. The names of imperfect states can still be used, and should be used when it is ambiguous to use the name of the perfect state.*

'For example, mycologists use, and it should be legal to use, *Cladosporium herbarum* Fr. despite the fact that its perfect state *Sphaerella Tulasnei* Jancz. has been found and verified. It may be misleading to cite, e.g., *Pyrenophora teres* from a country where only the *Helminthosporium* stage is known.'

I realize that Congress has rejected proposals to conserve specific names of Phanerogams, but I see no reason why mycologists should not give formal consideration to the above and other proposals aiming at clarification of the Rules for nomenclature of Fungi, and at stabilization of scientific names.

CONCLUSIONS AND PROSPECTS

By J. RAMSBOTTOM

The different aspects of nomenclature commented on by the previous speakers are obviously interwoven; indeed, it is obvious that the latter have practised a self-denying ordinance. What must always be borne in mind is the essential distinction between taxonomy and nomenclature. All decisions about status, whether they concern individual organisms or major groups, are taxonomy; nomenclature relates only to the names which shall be used when those taxonomic decisions have been made.

It follows from this that the plea for fixity of names concerns nomenclature. Rules of nomenclature aim at strict and clear applications of names; their object is stability, not change. Taxonomy on the other hand is ever changing, and as it can never reach perfection will continue to change; it cannot be kept in fetters by nomenclature. With every change in taxonomic rank there must be a corresponding change in name. Further there is the healthy symptom that systematists differ in their interpretation of facts, and mycologists, with a rapidly advancing subject, are liable to more than the average differences of opinion.

The one fixed point is the name or epithet used in a given rank. This has priority with the exceptions: (*a*) it must not antedate the starting point for the group, (*b*) there must not be a homonym in another group, (*c*) a generic name may have a later name conserved against it, (*d*) there must not already exist the same epithet in a genus to which a species is transferred—and this whether the old specific name is in use or not.

This brings us to Dr Bisby's proposal for conserving specific names. The same proposal has been brought forward at every international botanical congress and has always been rejected; it was included in a list of recommendations circulated by Dr C. L. Shear for consideration at Stockholm.

At first sight there appears no logical basis for not allowing specific *epithets* to be conserved in the same way, and for the same reasons, as generic names. The proposal has, however, always been for the conservation of specific *names*, i.e. the binary name consisting of a generic name and a specific epithet, and we then have taxonomic complications. It has to be realized that a fungus may have more than one valid name as a species, and valid names in other ranks. The genus *Tricholoma*, for example, has been split into several smaller genera, *Melanoleuca*, *Rhodopaxillus*, *Rhodocybe*, which may or may not be adopted. We immediately have two valid names for many species:

Tricholoma melaleucum (Pers. ex Fr.) Quél.
[*Melaleuca vulgaris* Pat. (non *Melaleuca* L. Myrtaceae).
Melanoleuca vulgaris (Pat.) Pat.].
Melanoleuca melaleuca (Pers. ex Fr.) n.comb.

Further, a species may be regarded by some authors as belonging to one genus, by others to another. Thus some species pass from *Clitocybe* to *Tricholoma* according to different authors, or from *Marasmius* to *Collybia*, from *Cantharellus* to *Clitocybe*, and so on. Again we may have at least two valid names.

As an example of different names according to rank, *Volvaria surrecta* (Knapp) Ramsb. is the correct name for the species, and *Volvaria hypopitys* subsp. *Loveiana* (Berk.) Konr. & Maubl. for the subspecies (see *Trans. Brit. myc. Soc.* xxv, 326 (1942)). It is because of difficulties such as these that I, personally, am not in favour of the proposal. We could eventually have a list of standardized fungus-names similar to the American horticulturists' 'Standardized Plant Names', but this would make for taxonomic stagnation.

On the other hand some restricted conservation of specific epithets might be advantageous. Every systematist must constantly come across specific epithets which antedate those in common use and thinks it well to pass them over. What is the better course to follow when one realizes that Balsamo first named the fungus of muscardine *Botrytis paradoxa*, and then, wishing to honour Bassi's classical researches on the disease, renamed it *Botrytis Bassiana*, a name universally adopted? Should one 'refuse to look out of the window' or should one adopt the attitude that a wrong should be righted and, transferring the species to the genus *Beauveria*, write *Beauveria paradoxa* (Bals.) n.comb.? The very fact that many hesitate to apply the Rules because of the consequences suggests that some modification is necessary.

The Rules permit of orthographic and typographic changes in names; in other words corrections of unintentional slips, as e.g. *Battarrea* for *Batarrea*. The changes made in generic (and specific) names by Clements and Shear are unfortunate because *The Genera of Fungi* is much used by students. Confusion is bound to follow the use in yeasts of *Isomyces* for *Debaryomyces*, *Thelis* for *Hanseniospora*, *Zonosporis* for *Schwanniomyces*, even if *Schizosaccharis* and *Zygosaccharis* can readily be collated with *Schizosaccharomyces* and *Zygosaccharomyces* respectively. These are not orthographic corrections, but new names. Consequently they can never be used unless the names they are intended to replace are invalid: they are still-born.

The two kinds of synonyms called obligate and facultative by Mr Mason require to be distinguished. It has been customary to call the former absolute synonyms or typonyms, as they are based on the same type (my colleague, Mr A. J. Wilmott, uses the term isonym for substitute names, i.e. the same concept and the same circumscription). They are purely nomenclatural in character. Very occasionally there is a homonym which is an absolute synonym, e.g. *Ashbya* Guilliermond and *Ashbia* Cif. & Frag., both with *Nematospora Gossypii* Ash. & Nowell as the type. The latter kind of synonyms, for which I know no special term, are taxonomic; they are *judged* to refer to the same genus or species.

The other matter referred to by Mr Mason is double citation; the special point he makes has been generally overlooked by mycologists.

Fifty years ago Oldfield Thomas, a former Museum colleague, distinguished various kinds of types and so was instrumental in getting more precision in defining types and eventually the adoption of the type method. Botanists were long in adopting this method. It was proposed by some American botanists at Vienna (1905) but was not accepted and for this and other reasons a separate American code was drawn up. At Brussels (1910) the International Congress adopted the type method for future work: at Cambridge (1930) the method was adopted in its entirety. The adoption of the type method has helped to clarify our ideas but it has not removed all our difficulties as many of its advocates assumed it would, overlooking the consequences of sound taxonomic work having been accomplished by other methods.

The Cambridge Congress laid down that when a species was transferred from one genus to another the name of the original author should be given in brackets followed by that of the author who made the transference. Previous to this it was sufficient to give the name of the latter. (The authority is not part of the name, but is merely an abbreviated —often too abbreviated—reference. It should never be used with a query if the type method is followed.) Zoologists do not use double citation of this kind. If a transference has been made the name of the original author is put in brackets, i.e. the authority who first made the transference is omitted.

The second author's name serves many uses, though these have mainly to do with the convenience of taxonomists. The zoological method obviates certain nomenclatural difficulties. Such difficulties occur when for some reason or other an investigator wrongly identifies a species on which he is working with one previously described, and transfers it correctly to another genus. His account may be full, excellent and well illustrated, and he may distribute specimens. His work may be outstanding and constantly referred to. What is to be done? There was some ambiguity in the Cambridge Rules and the subject was discussed at Amsterdam. It was decided 'When, on transference to another genus, the specific epithet has been applied erroneously in its new position to a different plant, the new combination must be retained for the plant on which the epithet was originally based, and must be attributed to the author who first published it'. This 'as to name only' treatment, 'excluding description', is illogical and detrimental to taxonomy. The main purpose of the use of the second authority, a reference to the reasons for making the transfer, is here converted into something which, at best, is an accidental transference made in error. As a mycologist I would prefer to see the error admitted and the specific epithet regarded as new, i.e. omit the author's name within brackets.

The method of double citation has been in more general use in mycology than in other groups, probably because Saccardo used it in his *Sylloge*. It has to be realized, however, that there it has nothing to do with the type method but simply means that the author whose name is within brackets first used the specific epithet for what is presumably the same species. The first species may be the type or it may not—the association of the two species may be nomenclatural or it may be taxonomic. Thus, the specific epithet *purpureum* probably gave Saccardo the clue to the identity of Tulasne's *Hypochnus* and Patouillard's *Helicobasidium*: Tulasne first used the epithet so his name goes within brackets. Many

such examples can be found in the *Sylloge* especially amongst parasitic species named after host plants, e.g. *Urocystis Gladioli*.

De Toni decided on taxonomic grounds that *Urocystis Gladioli* W. G. Sm. is the same species as *Uredo Gladioli* Requien, so (Requien). Requien's specimen was said to be in De Candolle's herbarium; no type of W. G. Smith's species can be found. Dodge and Laskaris based their *Papulaspora Gladioli* on Requien's description; they may be right, they may be wrong, but they have made the combination *Papulaspora Gladioli* (Req.) Dodge & Laskaris, and this name stands or falls according as Requien's species is, or is not a *Papulaspora*; if it falls there can be no *Papulaspora Gladioli*. *Urocystis Gladioli* W. G. Sm. does not come into this picture at all. (Incidentally it may be pointed out that Smith considered the possibility of his species being a *Papulaspora*.) While I was writing up these comments a paper by Hotson appeared which supports the idea widely held in this country that there are two different fungi concerned. He proposes the name *Papulaspora Gladioli* H. H. Hots. for *Papulaspora Gladioli* (Req.) Dodge & Laskaris. This name is both illegitimate and illogical in every way. If Hotson believed that Dodge and Laskaris are wrong in their determination he should have proposed an entirely new specific epithet. Until taxonomy has played its proper part it would be wise not to add further to the nomenclatural tangle.*

The point made by Dr Bisby about a fungus with a pleomorphic life-cycle having only one valid name is taken, I think, too literally. If the perfect stage is present, its name should be used; if the conidial stage alone, its name. Anything other than this is confusing and the point should be made clear in the Rules. We need not take into account such names as *Rhizomorpha subterranea* and *Sclerotium roseum*.

The various Congresses have apparently been lax in coming to decisions. There was no time to consider mycology in particular at Cambridge; at Amsterdam various proposals were shelved—I was mainly responsible for this, for it was obvious that we had not the facts on which to come to well-considered decisions. Points which were up for consideration were:

(1) *List of proposed nomina genera conservanda*. An original list had been prepared by Saccardo for the Vienna Congress but apparently was not published. Lists by Maire, Shear and Jaczewski were before the Amsterdam Congress, but as these were bald proposals it was unwise to vote on them. When nothing seemed likely to be done otherwise before the Stockholm Congress I proposed that the Council of the British Mycological Society should set up a Committee to provide the evidence on which judgment might be based. This Committee has done excellent work and has initiated several members into the problems of nomenclature in a practical and useful way.

(2) *Starting point for nomenclature*. The starting points adopted at Brussels were a compromise. There are again proposals (*a*) that Linné's *Species Plantarum* should be the starting point for all groups; (*b*) that Persoon's *Synopsis* should be taken as the starting point for other fungi as well as Rusts, Smuts and Gasteromycetes.

Until we know what sort of changes would be involved it would be foolish to make a change. In collaboration with Miss Stephens I am trying to get some idea of the effect of the adoption of either of these proposals.

(3) *Fries*, Systema Mycologicum (1821–1832). What interpretation is to be put upon this? One view is that the work and not the date is the important point, and that each group of fungi treated in the *Systema* has its starting point at the date it appeared there. Prof. C. W. Dodge had stressed the date: everything starts from 1821. I gained the impression that the majority at the meeting favoured Dodge's view. There can be little doubt that the former view is the more logical but the latter may be the more expedient. As there is a difference in interpretation, the obvious solution is to find out what practical differences in nomenclature would result, and then to adopt that bringing about least change in common practice.

(4) *Fries's subgenera of* Agaricus. The proposal to treat the subgenera in the *Systema* as of generic rank is an example of a proposal which might easily be adopted at a Congress through misunderstanding of the true position. Nothing would be gained by merely taking the *Systema*; indeed that is an understatement. The subgenera which have been used as if they were genera are those of *Hymenomycetes Europaei* 1874!

All these proposals need to be discussed and decisions made.

A further point that should be considered is the use of generic names in other than the

* The name *Papulaspora Dodgei* Conners has now been proposed to replace *P. Gladioli* H. H. Hots.

original sense. If we attempt to disregard the material differences that have arisen in the interpretation of some of these names there will be great confusion. Most mycologists have adopted Saccardo's interpretation of these generic concepts—a fact which led T. Petch to propose that mycological nomenclature should start with the *Sylloge*—and a way of implementing this practice should be adopted. I intend to put forward the proposal that when common usage follows Saccardo in using a generic name in a different sense from that in which it was originally proposed, Saccardo's name should be treated as a later homonym and conserved.

Also there is a need for some recognized method of quoting errors of identification. We have an appalling array of these in the genus *Russula*. Thus *Russula sardonia* Bres. as commonly written suggests that Bresadola wrongly proposed an illegitimate name for a new species of *Russula*, whereas what he did was to misidentify *Russula sardonia* Fr.

The suggestions made by Dr Bisby show that there is ambiguity in some of the Rules. Where this is so, the ambiguity should be removed. Examples of special cases would do much towards this end.

As I view the future of nomenclature its success or failure depends on the clear recognition of the cleavage between it and taxonomy. Nomenclature is the handmaiden of taxonomy, not the mistress.

PROCEEDINGS

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 21 February 1942.

The President, Miss E. M. BLACKWELL, M.Sc., F.L.S., in the Chair.

Morning Session

W. G. KEYWORTH. *Verticillium* Wilt of hops.

A detailed study of *Verticillium* Wilt of the hop was started at the East Malling Research Station in 1938 to follow up the work of Mr R. V. Harris.

The main symptoms are yellowing and desiccation of the leaves and brown discoloration of the wood in affected stems. The fungus most frequently isolated from affected plants is *Verticillium albo-atrum* but three outbreaks are known to have been caused by *V. Dahliae* (considered as distinct from *V. albo-atrum* because of constant cultural differences). *V. albo-atrum* has been isolated from the roots, stems and leaves of affected plants, and it often produces spores abundantly in the field on moribund stems and leaves.

Seventy-two outbreaks are known and wide variations in severity and persistence have been noted among them. Some fluctuate annually in severity and others become progressively more extensive year by year. The latter type has been studied in detail and observations and experiments have shown that the disease may be spread by the transport of infected plant debris on the cultivators, by the wind dispersal of infected leaves, and in diseased cuttings. Potatoes and raspberries affected with *Verticillium* Wilt have been found in association with wilted hops.

The control measures at present advised are mainly hygienic precautions, designed to remove sources of infection. Soil treatment with eight gallons of 2 % formalin per square yard reduces soil infection considerably and is now advised in attempting to eradicate new outbreaks. No commercial hop varieties are resistant although some seedling varieties show possible resistance.

F. BAKER. Decomposition of cellulose in dung by fungi and bacteria.

Cellulose is birefringent and the cellulose components of plant structures appear brilliantly illuminated between the crossed nicols of the polarizing microscope. Where disintegration of the cellulosic substratum is taking place double refraction ceases and such regions appear as dark patches of well-defined contour. Using a method based on these facts observations were made on the breakdown of cellulose which occurs under anaerobic conditions in the alimentary canal of domestic herbivora and that taking place under aerobic conditions in the voided faeces. The first of these processes which is due to the activity of idophile bacteria is exercised only upon substrata, such as the cellulosic components of young plant tissues, whose content of encrusting substances is very restricted. The second process, however, results from the activity of fungi, which is exercised upon the lignified structures that have accumulated in the large bowel; residues which for the most part derive from older vegetable materials. It has been ascertained by observations on the decomposition in dung of the epicarpal hairs of cereal grains, which are voided unchanged, that the cytoclastic process follows the lines of least resistance in the material and that the details of the process find a parallel in the fungal decomposition of wood tracheids. It is clear that the close parallel which can be drawn between the decomposition of dung and the rotting of wood devolves upon a distinctive functional characteristic of the agents of disintegration concerned; namely the ability, widespread among fungi, to gain access to the cellulose embodied in the fine-structural edifice of the ligno-cellulose complex.

Afternoon Session

Discussion on the use and misuse of nomenclature:

Miss E. M. WAKEFIELD. Why rules? (see p. 428).

E. W. MASON. New species and old (see p. 433).

G. R. BISBY. Who is the author? (see p. 434).

J. RAMSBOTTOM. Conclusions and prospects (see p. 436).

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 24 April 1942.

The President, Miss E. M. BLACKWELL, M.Sc., F.L.S., in the Chair.

C. T. INGOLD. Aquatic hyphomycetes of decaying oak leaves.

Miss D. ASHWORTH. A Papulaspora-like fungus from tulip bulbs.

The occurrence of *Papulaspora Gladioli* in America on gladiolus corms in store seems to make it worth while to record a similar fungus first isolated from tulip bulbs at the Royal Horticultural Society's Laboratory at Wisley, some fifteen years ago. No evidence of pathogenicity was obtained. The fungus was briefly described and evidence put forward for its acceptance as a *Papulaspora* though a specific name was not suggested.

C. G. DOBBS. Spore dispersal in the Mucorales.

Figures in current text-books which suggest that *Mucor* sporangia burst and disperse their spores in air are inaccurate, and in particular one of Brefeld's which is incorrectly described in several text-books as of a sporangium shedding its spores gives a false impression. It is uncertain what are referred to in many descriptions and drawings of sporangia, and the importance needs stressing of distinguishing clearly sporangia from sporangial drops, and of stating under what conditions sporangia are figured.

A simple technique for blowing spores has been found useful in separating and isolating fungi, as well as in testing their dispersal in air. The examination of mucors grown in specially built cells made of coverslip glass with a cellulose cement, and the use of simple pyrex glass spore blowers, have made it possible to distinguish a number of preliminary dispersion types among the Mucorales.

The main fact which emerges is that the *Mucor* sporangium is primarily a water-dispersal mechanism, and that *Mucor* spores for the most part become air-borne only after preliminary separation in water, and then usually on the surface of soil dust particles or hyphal fragments. *M. hiemalis* is an almost complete *spore-retainer* in air. *M. Rouxianus*, however, when over six months old disperses fragments of broken hyphae bearing separated spores or spore masses, when subjected to gentle blowing. *M. racemosus* distributes chlamydospores also in its hyphal fragments, as well as shedding some spore masses without hyphae. *Absidia glauca* is a *spore-mass-shedder* without much hyphal dispersal. It sheds no single spores but is well adapted both to air and water dispersal. *Rhizopus nigricans*, however, is definitely adapted to air dispersal. The rough spores are not readily water dispersed. The bell-shaped collapsed columella, long known, but still incorrectly figured in text-books, can remain erect on its rigid stalk, still able to shed viable spores, for as long as three years at least. Blowing broadcasts spore masses of varying size, and single spores provided the material is quite dry. It is therefore called a *dried-spore-shedder*. Finally, some of the conidial types are direct *spore-shedders* comparable with many hyphomycetes.

Realization that the *Mucor* sporangium is primarily a water-dispersal mechanism makes it more comparable with other soil fungi, especially the soil Oomycetes, and many of the variations from the *Mucor* type become intelligible as adaptations to air dispersal. The discovery of a new species of *Piptocephalis* growing on a *Penicillium* was reported, and a culture was shown of a large species of *Mucor* collected near Bristol, and identified provisionally as *Mucor plasmaticus* v. Tiegh.

P. H. GREGORY. Dissemination of fungus spores in air.

Investigations on the air transmission of fungus diseases to new areas generally give most attention to how far and how high spores are transported by air currents. There is little printed work giving details of the different amounts of disease (or the number of spores deposited) at short distances. Under field conditions, when the isolation of plants is generally incomplete, the relation between the degree of infection and distance from an infected area is at times important, and from the fact that certain series of printed observations on a number of diseases are in agreement with Stepanoff's formula $y=C+\frac{a}{sx}$ it is thought that the dissemination in air of spores is a process which may be measured quantitatively.

E. C. BADCOCK. Exhibit of sporophores of some wood-rotting fungi produced in culture on sawdust medium.

PHYTOPATHOLOGICAL EXCURSION 1942

The seventeenth Annual Phytopathological Excursion was held at the Department of Plant Pathology at Rothamsted Experimental Station, Harpenden, by invitation of Mr F. C. Bawden, Head of the Department, on Friday, July 24th, 1942. During the morning informal demonstrations were given of the work on virus diseases and diseases of cereals in progress in the laboratories. A demonstration of the methods used in spectroscopic plant analysis was given immediately before lunch by Dr J. B. Hale. The afternoon was given up to field demonstrations arranged by the Sub-Committee on Plant Disease Measurement to illustrate their methods. Much interest was shown in this work and many promises of help were received. About forty members and guests were present.

LIST OF MEMBERS

Correct to 18 November 1942

Honorary Members

Lister, Miss Gulielma, F.L.S., 871 High Road, Leytonstone, London, E. 11. (1903.) (1924.)
Maire, René, D.Sc., F.M.L.S., Professeur à la Faculté des Sciences de l'Université, Algiers, Algeria, N. Africa. (1907.) (1939.)
Petch, T., B.A., B.Sc., North Wootton, King's Lynn, Norfolk. (1911.) (1941.)
Rea, Carleton, B.C.L., M.A., 6 Barbourne Terrace, Worcester. (1896.) (1918.)
Wakefield, Miss E. M., M.A., F.L.S., Herbarium, Royal Botanic Gardens, Kew, Surrey. (1911.) (1941.)

Ordinary Members

Aberdeen, The University Library. (1916.)
Adams, Rev. J. H., Landulph Rectory, Hatt, Saltash, Cornwall. (1919.)
Ainsworth, G. C., B.Sc., Ph.D., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1931.)
Alaily, Y. A. S. El, Mycological Section, Cotton Research Board, Giza, Egypt. (1935.)
Alberta, University of Edmonton, Alberta, Canada. (1924.)
Alcock, Mrs N. L., M.B.E., F.L.S., 61 Holywell, Oxford. (1919.)
Armitage, F. D., A.R.P.S., F.R.M.S., Bargrove Lodge, Boxmoor, Herts. (1942.)
Ashby, S. F., B.Sc., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1926.)
Bacon, Mrs Alice, B.Sc., F.L.S., Technical College, Brighton, Sussex. (1938.)
Barnes, B., D.Sc., Ph.D., V.-P.L.S., Chelsea Polytechnic, London, S.W. 3. (1922.)
Barr, Rev. Robert, T.D., M.A., The Manse, Neilston, Renfrewshire. (1918.)
Barrington, Dr F. J. F., 48 Wimpole Street, London, W. 1. (1901.)
Bartlett, A. W., M.A., M.Sc., F.L.S., Department of Botany, King's College, Newcastle-on-Tyne. (1920.)
Baruah, Hitendra Kumar, M.Sc., The Botany School, Cambridge. (1938.)
Bates, G. R., Ph.D., c/o British South Africa Company, Mazoe Citrus Estate, Mazoe, S. Rhodesia. (1930.)
Bawden, F. C., M.A., Rothamsted Experimental Station, Harpenden, Herts. (1941.)
Beardslee, H. C., Perry, Ohio, U.S.A. (1933.)
Beaumont, Albert, M.A., Seale-Hayne Agricultural College, Newton Abbot, Devon. (1924.)
Bewley, W. F., C.B.E., D.Sc., Experimental and Research Station, Cheshunt, Herts. (1922.)
Biffen, Professor Sir Rowland H., M.A., F.R.S., 136 Huntingdon Road, Cambridge. (1899.)
Biologist, Plant Research Laboratory, Horticultural Gardens, Burnley, Victoria, Australia. (1921.)
Birmingham Natural History and Philosophical Society, c/o Mrs O. W. Thompson, 18 Hermitage Road, Edgbaston, Birmingham. (1920.)
Bisby, Guy R., Ph.D., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1921.)
Blackman, Professor V. H., M.A., Sc.D., F.R.S., F.L.S., 17 Berkeley Place, Wimbledon, London, S.W. 19. (1900.)
Blackwell, Miss Elizabeth Marianne, M.Sc., F.L.S., Botanical Department, Royal Holloway College, Englefield Green, Surrey. (1917.)
Blumer, Dr S., Myrtenweg 12, Bern-Bumpliz, Switzerland. (1936.)
Bonn, Germany, Institut für Pflanzenkrankheiten, Nuss-Allee 9. (1931.)
Boston, The Mycological Club, Horticultural Hall, Boston, Mass., U.S.A. (1926.)
Bourgin, Dr Viennot, École Nationale d'Agriculture de Grignon, Seine-et-Oise, France. (1936.)
Braid, Professor K. W., B.A., B.Sc., West of Scotland Agricultural College, 6 Blythswood Square, Glasgow. (1922.)

Brazier, E., Ty'n-y-gongl, Love Lane, Stourbridge. (1921.)
Brenchley, G. H., B.A., Clare College, Cambridge. (1925.)
Brett, Miss M., M.Sc., Ph.D., F.L.S., Northern Polytechnic, Holloway Road, London, N. 7. (1921.)
Brierley, Professor W. B., D.Sc., F.R.A.I., F.L.S., Department of Agricultural Botany, The University, Reading. (1919.)
British Museum, The Trustees of, Cromwell Road, South Kensington, London, S.W. 7. (1914.)
Brooks, Professor F. T., M.A., F.R.S., F.L.S., The Botany School, Cambridge. (1907.)
Brown University, Library, East side Station, Providence, R.I., U.S.A. (1920.)
Brown, Professor W., M.A., D.Sc., F.R.S., Imperial College of Science, South Kensington, London, S.W. 7. (1922.)
Bruxelles, Jardin Botanique de l'État, c/o M. P. van Aerdschot. (1911.)
Buckley, W. D., 'St Anthony', Leigh Park, Datchet, Bucks. (1916.)
Buddin, Walter, M.A., Laboratory of Plant Pathology, University of Reading, 7 Redlands Road, Reading. (1921.)
Buller, Professor A. H. R., D.Sc., Ph.D., F.R.S., c/o Herbarium, Royal Botanic Gardens, Kew, Surrey. (1911.)
Bunting, R. H., F.L.S., 3 Stanton Court, Weymouth. (1921.)
Burges, N. A., The Botany School, Cambridge. (1935.)
Burr, S., M.Sc., Department of Agriculture, The University, Leeds. (1924.)
Butler, Sir E. J., C.I.E., C.M.G., D.Sc., M.B., F.R.S., F.L.S., 22 Newnham Avenue, Bedford. (1920.)
Caldwell, J., D.Sc., Ph.D., Department of Botany, University College, Exeter. (1932.)
Callen, E. O., 9 Lauderdale Street, Edinburgh, 9. (1941.)
Cambridge, The Botany School. (1920.)
Campbell, A. H., B.Sc., Ph.D., Department of Botany, The University, Bristol. (1934.)
Carmichael Medical College, Belgachia Road, Calcutta, India. (1922.)
Carrothers, E. N., L.M.S. Railway, York Road Station, Belfast. (1925.)
Cartwright, K. St G., M.A., F.L.S., The Old Vicarage, Towersey, Thame, Oxon. (1913.)
Cayley, Miss Dorothy M., Foxhall Cottage, Kelshall, nr. Royston, Herts. (1913.)
Charles, Miss Vera K., United States Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1933.)
Chaudhuri, Professor H., M.Sc., Ph.D., University of the Punjab, Lahore, India. (1920.)
Cheal, W. F., Gosmoor Lane, Elm, nr. Wisbech, Cambs. (1927.)
Chesters, C. G. C., B.Sc., M.Sc., Ph.D., Department of Botany, The University, Edgbaston, Birmingham. (1930.)
Ciferri, Professor Dr R., Assistant Director, Laboratorio Crittogamico, Casella Postale 165, Pavia, Italy. (1926.)
Clapham, A. R., M.A., Ph.D., Department of Botany, The University, Oxford. (1931.)
Cleland, J. Burton, M.D., Professor of Pathology, University of Adelaide, South Australia. (1918.)
Clouston, D., M.A., B.Sc. (Agr.), North of Scotland College of Agriculture, Crown Mansions, 41 Union Street (2nd Floor), Aberdeen. (1931.)
Colson, Miss B., B.Sc., Ph.D., Department of Botany, The University, Reading. (1934.)
Connecticut Agricultural Experiment Station, New Haven, Connecticut, U.S.A. (1929.)
Cook, W. R. I., B.Sc., Ph.D., Department of Botany, University College, Newport Road, Cardiff. (1924.)
Cooke, G. J., 143 Newmarket Road, Norwich. (1933.)
Cooke, Mrs G. J., 143 Newmarket Road, Norwich. (1937.)
Cooper, Miss Charlotte A., California Lane, Bushey Heath, Herts. (1911.)
Cooper, Mrs V. Astley, South Lodge, Reading Road, Cholsey, Wallingford, Berks. (1921.)
Cornell University, The Library, New York State College of Agriculture, Ithaca, N.Y., U.S.A. (1920.)

Corner, E. J. H., M.A., F.L.S., Assistant Director, Botanic Gardens, Singapore, Straits Settlements. (1924.)
Cotton, Arthur D., O.B.E., F.L.S., Keeper, Herbarium, Royal Botanic Gardens, Kew, Surrey. (1902.)
Croxall, H. E., B.Sc., Research Station, Long Ashton, Bristol. (1937.)
Curtis, Miss Kathleen M., M.A., D.Sc., D.I.C., F.L.S., Mycologist, Biological Department, Cawthron Institute of Scientific Research, Nelson, New Zealand. (1917.)
Cutting, E. M., M.A., F.L.S., Botanical Department, University College, Gower Street, London, W.C. 1. (1920.)
Dade, H. A., A.R.C.S., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1927.)
Davies, D. L. G., Ph.D., Agricultural Buildings, University College of Wales, Aberystwyth. (1938.)
Davies, D. W., B.Sc., Adviser in Mycology, Agricultural Buildings, University College of Wales, Aberystwyth. (1923.)
Day, W. R., B.A., B.Sc., Imperial Forestry Institute, Oxford. (1928.)
Deacon, Dr G. E., Brundall, Norwich. (1933.)
Dehra Dun, The Forest Botanist, Forest Research Institute and College, U.P., India. (1929.)
Deighton, F. C., M.A., Mycologist, Department of Lands and Forests, Freetown, Sierra Leone, West Africa. (1925.)
Delhi, Imperial Mycologist, Imperial Agricultural Research Institute, Delhi, India. (1921.)
Dennis, R. W. G., Ph.D., Plant Pathology Service, Seed Testing Station, East Craigs, Edinburgh, 12. (1932.)
Dickinson, S., Ph.D., School of Agriculture, Cambridge. (1921.)
Dobbs, C. G., B.Sc., Ph.D., Botanical Department, King's College, Strand, London, W.C. 2. (1933.)
Dodge, Dr Carroll W., Missouri Botanical Garden, 2315 Tower Grove Avenue, St Louis, Missouri, U.S.A. (1926.)
d'Oliveira, Dr Branquinho, Linha de Cascaes, Parede, Portugal. (1939.)
Dowson, W. J., M.A., D.Sc., The Botany School, Cambridge. (1920.)
Duncan, J. T., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1930.)
Dunston, Capt. Ambrose E. A., Burltons, Donhead St Mary, Wiltshire (via Shaftesbury). (1937.)
Elliott, Mrs J. S. Bayliss, D.Sc. (B'ham), B.Sc. (London), Arden Grange, Tanworth-in-Arden, Warwickshire. (1911.)
Ellis, E. A., Castle Museum, Norwich. (1937.)
Ellis, E. H., B.Sc., Gramarye, Farley Green, Guildford, Surrey. (1936.)
Emerson, R., Dept. of Botany, University of California, Berkeley, Calif., U.S.A. (1938.)
Emoto, Dr Y., Biological Department, Peers' College (Gakushuin), Mejiromachi, Tokyo, Japan. (1929.)
Essex Field Club, c/o Mr Percy Thompson, F.L.S., Essex Museum of Natural History, Romford Road, Stratford, London, E. 15. (1919.)
Exeter, Librarian, University College of the South-West of England. (1926.)
Eyre, Miss J. C., Wellbottom Lodge, Moulton, nr. Newmarket. (1915.)
Fenton, E. W., M.A., B.Sc., F.L.S., Biology Department, Edinburgh and East of Scotland College of Agriculture, Edinburgh. (1920.)
Findlay, W. P. K., D.Sc., A.R.C.S., Forest Products Research Laboratory, Princes Risborough, Bucks. (1928.)
Finlayson, Raymond A., F.L.S., Official Seed Testing Station, Huntingdon Road, Cambridge. (1910.)
Fisher, S. D. P., Sackville Street, Leeds. (1930.)
Fitzpatrick, Professor H. M., Ph.D., 220 Bryant Avenue, Ithaca, New York, U.S.A. (1935.)
Fletcher, Mrs P. T., B.A., 137 Tonbridge Road, Maidstone, Kent. (1935.)

Foister, C. E., B.A., Ph.D., Plant Pathology Service, Seed Testing Station, East Craigs, Edinburgh, 12. (1940.)
Fraser, Miss Lilian R., D.Sc., Botany School, The University, Sydney, New South Wales. (1938.)
Gadd, C. H., D.Sc., Tea Research Institute, Nuwara Eliya, Ceylon. (1921.)
Gardner, Capt. Frederic, c/o Barclays Bank, Jersey, C.I. (1898.)
Garrett, S. D., M.A., Ph.D., Rothamsted Experimental Station, Harpenden, Herts. (1936.)
Ghamrawy, Ali K., 39 Monirah Street, Cairo, Egypt. (1932.)
Gilbert, E. J., Docteur en Pharmacie, 4 Rue de Musset, Paris (16ᵉ), France. (1924.)
Gilbert, Dr E. M., Botanical Department, University of Wisconsin, Madison, Wis., U.S.A. (1922.)
Gill, G. E., LL.B., Law Library, Four Courts, Dublin. (1937.)
Gillespie, J., B.Sc., Botany Dept., University of Reading. (1938.)
Gilson, Mrs M. R. [née Brown], Newnham College, Cambridge. (1936.)
Glenn, Miss E. M., B.Sc., East Malling Research Station, nr. Maidstone, Kent. (1942.)
Glynne, Miss Mary D., M.Sc., F.L.S., Rothamsted Experimental Station, Harpenden, Herts. (1932.)
Gorman, M. J., A.R.C.Sc.I., Albert Agricultural College, Glasnevin, Dublin. (1925.)
Gould, F. G., Woodrising, Trapps Hill, Loughton, Essex. (1918.)
Graddon, W. D., Berry Bank, Howey Hill, Congleton, Cheshire. (1942.)
Gray, Miss E. G., B.Sc., Ph.D., West of Scotland Agricultural College, 6 Blythswood Square, Glasgow. (1942.)
Gregory, P. H., Ph.D., Rothamsted Experimental Station, Harpenden, Herts. (1930.)
Grinling, C. H., B.A., 71 Rectory Place, Woolwich, London, S.E. 18. (1913.)
Groves, J. Walton, Central Experiment Farm, Ottawa, Canada. (1942.)
Gwynne-Vaughan, Professor Dame Helen, G.B.E., D.Sc., LL.D., F.L.S., 93 Bedford Court Mansions, London, W.C. 1. (1906.)
Hanna, W. F., M.Sc., Ph.D., Dominion Rust Research Laboratory, Agricultural College, Winnipeg, Canada. (1925.)
Hansford, C. G., M.A., F.L.S., Mycologist, Department of Agriculture, Kampala, Uganda. (1921.)
Harley, J. L., M.A., D.Phil., Department of Botany, The University, Oxford. (1932.)
Harris, G. C. M., 148 Divinity Road, Oxford. (1934.)
Harris, R. V., B.Sc., A.R.C.S., East Malling Research Station, nr. Maidstone, Kent. (1924.)
Harrison, T. H., D.Sc., Australia House, Strand, London, W.C. 2. (1931.)
Harvard University, The Library, Cambridge, Mass., U.S.A. (1923.)
Hastings, Somerville, M.S., F.R.C.S., 43 Devonshire Street, Portland Place, London, W. 1. (1913.)
Hawker, Miss L. E., Ph.D., Botanical Department, Imperial College of Science, South Kensington, London, S.W. 7. (1934.)
Heim, Roger, Sous-Directeur au Muséum d'Histoire Naturelle, 11 Rue de Médicis, Paris (6ᵉ), France. (1930.)
Heimbeck, Mrs Louise, Brosoe, Levanger, Norway. (1923.)
Hemmi, Dr Takewo, Phytopathological Institute, Department of Agriculture, Kyoto Imperial University, Kyoto, Japan. (1923.)
Hereford, E. H., 131 Queen Victoria Street, London, E.C. 4. (1933.)
Hickman, C. J., M.Sc., Long Ashton Research Station, Field Laboratory, Abbey Road, Evesham. (1935.)
Holden, H. S., D.Sc., F.R.S.E., F.L.S., Forensic Science Laboratory, Burton Street, Nottingham. (1923.)
Honolulu, Association of Hawaiian Pineapple Canners, P.O. Box 3166, Hawaii. (1929.)
Honolulu, The Library, Experimental Station, S.P.A., Box 411, Hawaii. (1920.)
Howard, H. J., F.R.M.S., F.L.S., Lingfield, 6 College Road, Norwich. (1918.)
Hubbard, Miss M. D., B.Sc., Laren, Western Drive, Littleover, Derby. (1933.)

Hughes, G. C., Priory Road, Bicester. (1898.)
Hughes, J. S., M.A., The Firs, Great Rollright, Chipping Norton, Oxon. (1927.)
Hughes, S. J., B.Sc., Advisory and Research Dept. in Agricultural Botany, University College, Cathays Park, Cardiff. (1941.)
Hull, R., B.Sc., Ph.D., A.R.C.S., Midland Agricultural College, Sutton Bonington, Loughborough. (1942.)
Hull, The Librarian, Botanical Department, University College. (1929.)
Humphrey, Dr C. J., 543 No. La Cienega Blvd., Los Angeles, California. (1921.)
Hurst, C. P., F.L.S., Landulph Rectory, Saltash, Cornwall. (1928.)
Ingold, C. T., D.Sc., Ph.D., F.L.S., Department of Botany, University College, Leicester. (1935.)
Iowa, The Library, State University of Iowa, Library Annex, Iowa City, U.S.A. (1923.)
Iowa State College, Library, Ames, Iowa, U.S.A. (1927.)
Issatchenko, Professor Dr B. L., Nowinskii B. 25, log. 11, Moscow 69, U.S.S.R. (1923.)
Jenkins, Miss Anna E., Bureau of Plant Industry, Department of Agriculture, Washington, D.C., U.S.A. (1942.)
John Crerar Library, 86 East Randolph Street, Chicago, Illinois, U.S.A. (1929.)
Johnstone, R. H., 726 Anniesland Road, Glasgow, W. 4. (1938.)
Jones, G. H., M.A., Kasenga, Stanley Avenue, Chesham, Bucks. (1922.)
Jørstad, Ivar, Statsmykolog, Botanisk Museum, Oslo, Norway. (1923.)
Keay, Miss M. A., M.A., Ph.D., Department of Agricultural Botany, The University, Reading. (1935.)
Keissler, Dr Karl, Direktor d. Botanischen Abteilung, Naturhistorisches Museum, Burgring 7, Wien 1/1, Austria. (1924.)
Kelly, Dr Howard A., 1418 Eutaw Place, Baltimore, Md., U.S.A. (1921.)
Keyworth, W. G., Ph.D., D.I.C., East Malling Research Station, nr Maidstone, Kent. (1941.)
Klika, Bohumil, Hálkova, 37 Prague, Vrsovice 553 Czechoslovakia. (1926.)
Knight, H. H., M.A., The Lodge, All Saints' Villas, Cheltenham. (1914.)
Kuala Lumpur, F.M.S., The Director of Agriculture, Straits Settlements and Federated Malay States. (1930.)
Leach, R., B.A., Department of Agriculture, Kingston, Jamaica. (1929.)
Leicester, The Museum, City of Leicester. (1923.)
Likhite, Dr Y. N., Department of Agriculture, Baroda State, India. (1936.)
Linder, Dr D., Farlow Herbarium, Harvard University, 20 Divinity Avenue, Cambridge, Mass., U.S.A. (1935.)
Line, James, M.A., School of Agriculture, Cambridge. (1921.)
Linnean Society, The, Burlington House, Piccadilly, London, W. 1. (1919.)
Lloyd Library, The, 309 West Court Street, Cincinnati, Ohio, U.S.A. (1907.)
Loader, Miss F. M., B.Sc., Botanical Department, University College, Southampton. (1927.)
Long, Mrs E. M. [née Ellis], B.A., B.Sc., Riversdale, Waddington Road, Clitheroe, Lancs. (1930.)
Lütjeharms, Professor W. J., Phil.Nat.D., Department of Botany, University College, Bloemfontein, Orange Free State, S. Africa. (1930.)
Macdonald, James A., Botany Department, The University, St Andrews. (1938.)
McKay, Robert, B.Sc., A.R.C.S.I., Department of Plant Pathology, Albert Agricultural College, Glasnevin, Dublin. (1939.)
Manchester, The University of, Department of Cryptogamic Botany, Manchester. (1940.)
Marsh, R. W., M.A., Research Station, Long Ashton, Bristol. (1923.)
Masefield, G. B., c/o Department of Agriculture, Entebbe, Uganda. (1932.)
Mason, E. W., M.A., M.Sc., F.L.S., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1921.)
Mason, Mrs E. W., M.Sc., Inglenook, 63 King's Road, Richmond, Surrey. (1922.)
Mathias, W. T., B.Sc., The University, Liverpool. (1938.)

Matthews, Professor J. R., M.A., F.L.S., Department of Botany, The University, Old Aberdeen. (1921.)
Mehta, Professor K. C., Ph.D., Department of Biology, Agra College, Agra, U.P., India. (1921.)
Metcalfe, C. R., B.A., Ph.D., Jodrell Laboratory, Royal Botanic Gardens, Kew, Surrey. (1926.)
Michigan Agricultural College Library, East Lansing, Michigan, U.S.A. (1924.)
Miller, Professor J. H., B.S., M.S., Ph.D., University of Georgia, Athens, Ga., U.S.A. (1930.)
Millidge, P. H., 205 Carisbrooke Road, Newport, I.O.W. (1937.)
Missouri Botanical Garden, The, St Louis, Mo., U.S.A. (1902.)
Mitra, M., M.Sc., Ph.D., D.I.C., Assistant Mycologist, Imperial Institute of Agricultural Research, Delhi, India. (1928.)
Miyabe, Dr Kingo, Professor Emeritus of Botany, Hokkaido Imperial University, Sapporo, Japan. (1919.)
Montague, Mrs A., Penton, Crediton, N. Devon. (1898.)
Montgomery, H. B. S., B.A., Ph.D., D.I.C., East Malling Research Station, nr. Maidstone, Kent. (1940.)
Montreal, Institut Botanique de l'Université, 4101 Est, Rue Sherbrooke, Canada. (1932.)
Moore, M. H., East Malling Research Station, nr. Maidstone, Kent. (1940.)
Moore, W. C., M.A., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1922.)
Morgan, Dr G., Ashley-Hatton, Dyke Road Avenue, Brighton. (1928.)
Morris, L. E., c/o Eton College, Windsor, Berks. (1924.)
Muller, Dr H. R. A., c/o Internatio, Semarang, Java. (1932.)
Murray, G. H., F.E.S., Director of Agriculture, Rabaul, New Britain, Territory of New Guinea, via Australia. (1921.)
Muskett, A. E., M.Sc., A.R.C.S., Queen's University, Belfast, Northern Ireland. (1923.)
Nannfeldt, Professor J. A., Sturegatan 11, Uppsala, Sweden. (1932.)
Nash-Wortham, J. R. H., Abingdon, Gatesden Road, Fetcham, Leatherhead, Surrey. (1937.)
National Collection of Type Cultures, Curator, Lister Institute, Elstree, Herts. (1921.)
National Museum of Wales, Cardiff. (1924.)
Nattrass, R. M., B.Sc. (Agric.), Ph.D., Department of Agriculture, P.O.B. 338, Nairobi, Kenya. (1925.)
Nederlandsche Mycologische Vereeniging, The Librarian, Zoornweg 10, Wageningen, Holland. (1920.)
Neiderhausen, J. S., Dept. of Plant Pathology, New York State College of Agriculture, Cornell University, Ithaca, N.Y., U.S.A. (1941.)
Newcastle-on-Tyne, The Librarian, King's College. (1928.)
New York Botanical Garden, Bronx Park, New York, U.S.A. (1904.)
Noble, Miss Mary, B.Sc., Ph.D., 19a Willowbrae Avenue, Edinburgh. (1940.)
Noel, Miss E. F., F.L.S., 37 Burnham Court, Queen's Road, London, W. 2. (1913.)
North Carolina, Library, University of, Chapel Hill, North Carolina, U.S.A. (1920.)
Notley, Miss M. E., O.C.H.F., St Mary's Convent, Baldslow, St Leonards-on-Sea, Sussex. (1942.)
Nursery and Market Garden Industries' Development Society, Ltd., Experimental and Research Station, Cheshunt, Herts. (1922.)
O'Connor, P., Ph.D., B.Sc., A.R.C.Sc.I., National Museum, Dublin. (1925.)
Ogilvie, L., M.A., M.Sc., Research Station, Long Ashton, nr Bristol. (1922.)
Oke, Alfred William, B.A., F.G.S., F.L.S., 32 Denmark Road, Hove, Sussex. (1908.)
Olliver, C. W., c/o Lloyds Bank Ltd., 50 Notting Hill Gate, London, W. 11. (1942.)
Ontario Agricultural College, Library, Guelph, Ontario, Canada. (1920.)
Osborn, Professor T. G. B., D.Sc., F.L.S., Department of Botany, The University, Oxford. (1910.)
Oyler, Miss E., Experimental and Research Station, Cheshunt, Herts. (1937.)

Padwick, Dr G. Watts, Imperial Agricultural Research Institute, New Delhi, India. (1936.)
Page, Miss W. M., M.Sc., Ph.D., 5 Dartmouth Chambers, Theobald's Road, London, W.C. 1. (1921.)
Parke Davis and Co., Medical Research Library, P.O. Box 488, Detroit, Michigan, U.S.A. (1920.)
Parker, Professor C. S., Department of Botany, Howard University, Washington, D.C., U.S.A. (1932.)
Patrick, Miss S. H. M., Elmsleigh House, Stoughton Avenue, Leicester. (1937.)
Pearson, Arthur A., F.L.S., Nutcombe House, Hindhead Road, Hindhead, Surrey. (1911.)
Peklo, Dr Jaroslav, Professor of Applied Botany, Bohemian Technical University, Charles Square, Prague II, Czechoslovakia. (1924.)
Pershouse, Mrs Stanley, Denhem Lodge, Yelverton, S. Devon. (1937.)
Perthshire Society of Natural Science, c/o J. F. Cumming, Esq., 12 Barossa Place, Perth. (1919.)
Pethybridge, G. H., O.B.E., Ph.D., B.Sc., F.L.S., Penlee, Harleigh Road, Bodmin, Cornwall. (1919.)
Peyronel, Dr Benjamino, R. Istituto Sup. Agrario e Forestale, Piazzale del Re, Firenze, Italy. (1932.)
Philadelphia, The Academy of Natural Sciences of Philadelphia, Nineteenth and The Parkway, Phil., U.S.A. (1925.)
Phillips, Dr H. H., 11 Kings End, Bicester, Oxon. (1923.)
Ping, A. Wentworth, M.A., St Olave's, Clifton, York. (1926.)
Potter, Rev. M. C., Sc.D., M.A., F.L.S., Corley Croft, New Milton, Hants. (1896.)
Preston, N. C., B.Sc., Harper Adams Agricultural College, Newport, Salop. (1920.)
Pretoria, South Africa, The Librarian, Division of Botany and Plant Pathology, P.O. Box 994. (1922.)
Ramsbottom, J., O.B.E., Dr.Sc., M.A., F.L.S., British Museum (Nat. Hist.), Cromwell Road, South Kensington, London, S.W. 7. (1910.)
Rauter, Dr F., 28 Clarendon Road, London, W. 11. (1942.)
Ray, Miss Anne, Penarwyn, Gorran Haven, Gorran, Cornwall. (1929.)
Rayner, Dr M. Cheveley (Mrs Neilson Jones), Bedford College for Women, Regent's Park, London, N.W. 1. (1921.)
Rees, John, M.Sc., Adviser in Agricultural Botany, University College, Cardiff. (1929.)
Reichert, Dr Israel, Jewish Agency for Palestine, Agricultural Experiment Station, P.O.B., 15 Rehoboth, Palestine. (1924.)
Rhodes, Miss Mabel, Lister Institute, Chelsea Gardens, London, S.W. 1. (1921.)
Robinson, E., 26 Burwood Avenue, Eastcote, Pinner, Middlesex. (1938.)
Rothamsted Experimental Station, Department of Plant Pathology, Harpenden, Herts. (1923.)
de Rousset-Hall, O., B.A., Department of Botany, The University, Oxford. (1942.)
Royal Holloway College, Englefield Green, Surrey. (1942.)
Rutgers College and State University of New Jersey, Library, New Brunswick, New Jersey, U.S.A. (1922.)
St Paul, Minnesota, U.S.A., The Library, Department of Agriculture University Farm. (1920.)
Sampson, Miss K., M.Sc., Agricultural Buildings, Aberystwyth, North Wales. (1920.)
Samuel, Geoffrey, M.Sc., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1923.)
Scott, W. W., 13 Bishop's Road, Highgate, London, N. 6. (1922.)
Searle, G. Odell, B.Sc. (Agric.), Flax Research Institute, Flitcham Abbey, nr King's Lynn, Norfolk. (1920.)
Seth, N. L., B.Sc., Ph.D., D.I.C., Agricultural College, Mandalay, Burma. (1930.)
Shear, Dr C. L., U.S. Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1930.)
Skene, Professor Macgregor, Department of Botany, The University, Bristol. (1936.)

Smith, Alexander, M.A., Ph.D., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1924.)
Smith, G., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1936.)
Smith, Professor Noel J. G., Ph.D., B.Sc., Botany Department, Rhodes University College, Grahamstown, S. Africa. (1924.)
Smith, Rupert, 38 Greenhill Gardens, Edinburgh. (1927.)
South London Botanical Institute, 323 Norwood Road, Tulse Hill, London, S.E. 24. (1921.)
Sowter, F. A., 9 North Avenue, Leicester. (1942.)
Stakman, Professor E. C., University of Minnesota, Department of Agriculture, University Farm, St Paul, Minn., U.S.A. (1922.)
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PRINTED IN GREAT BRITAIN BY
W. LEWIS, M.A., AT THE
UNIVERSITY PRESS, CAMBRIDGE